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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 39016, 39136, 39145, 39806, 40712, and 40732.

38870 (AI-CE-74) HEAVY WATER ORGANIC COOLED REACTOR. DETERMINATION OF TOTAL OXYGEN IN Al–Al_2O_3 ALLOYS BY FAST NEUTRON ACTIVATION ANALYSIS. Bramlitt, Edward T. (Atomics International, Canoga Park, Calif. Combustion Engineering, Inc., Windsor, Conn.). Aug. 15, 1967. Contract AT(38-1)-430. 27p. Dep. CFSTI.

A method for the determination of the oxygen content of Al–Al_2O_3 alloys, using fast neutron activation analysis, is described. Equipment with automatic control and techniques for improving the precision of measurements are specified. Over the range of 100 to 3000 mg oxygen, a precision of 1 to 3% (relative) is attainable, using dual sample irradiation with dual axis rotation during irradiation. The use of Lucite as an oxygen standard provides a stable, easily prepared reference material for the comparator technique used in activation analysis. Samples can be prepared, analyzed, and the data reported in much less than one hour per sample. (auth)

38871 (CEA-R-3098) ETUDE D'UNE METHODE DE DETECTION DU PLUTONIUM PAR SPECTROGRAPHIE X. APPLICATION A LA MESURE DES CONTAMINATIONS SUR L'HOMME. (X-Spectrographic Method for Plutonium Detection. Application to Contamination Measurements in Humans). Trouble, Michel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1967. 59p. (In French). Dep.

Thesis. Submitted to Univ., Paris.

After reviewing the radiotoxicology of plutonium-239 and conventional detection methods using its α radiation, measurement of the x emission spectrum of plutonium-239 using a proportional counter filled with argon under pressure was considered. This preliminary work led to study of the possibilities of applying thin alkali halide crystal scintillators to the detection of soft plutonium x-rays; there follows a systematic study of all the parameters liable to render the detection as sensitive as possible: movement due to the photomultiplier itself and its accessory electronic equipment, nature and size of the crystal scintillator as well as its mode of preparation and shielding against external parasitic radiation. Examples of some applications to the measurement of contamination in humans give an idea of the sensitivity of this method. (auth)

38872 (NBL-239) PLUTONIUM NITRATE SOLUTIONS. SUMMARY OF THE RESULTS OF THE GENERAL ANALYTICAL EVALUATION PROGRAM, JULY 1965–JUNE 1966. Roszkowski, E. S. (New Brunswick Lab. (AEC), N. J.). Apr. 1967. 35p. Dep. CFSTI.

The plutonium content and isotopic assays of ^{239}Pu and ^{241}Pu were the analyses considered in a program for plutonium nitrate solutions in the General Analytical Evaluation (GAE) Program. Eleven laboratories contributed analytical data for the GAE program. The samples distributed were either plant process solutions or reference standard solutions randomly selected, one sample per month, starting July 1965, and continuing for twelve months. A variety of procedures was used. The process solutions and synthetic solutions data were treated in separate groups. A measure of the laboratory's reproducibility, as well as its reproducibility relative to the sample averages, are indicated in the data. (D.H.M.)

38873 (NLCO-999) A REVIEW OF SPECTROCHEMICAL EMISSION METHODS AND ASSOCIATED PROBLEMS FOR THE DETERMINATION OF IMPURITIES IN NUCLEAR GRADE URANIUM. Pepper, C. E. (National Lead Co. of Ohio, Cincinnati). June 1, 1967. Contract AT(30-1)-1156. 44p. (CONF-670636-1). Dep. CFSTI.

From 13th International Spectroscopy Colloquium, Ottawa, Canada.

A review of spectrochemical arc and spark methods used throughout the world for determination of impurities in nuclear grade uranium is presented. The advantages and disadvantages of the various methods are discussed. The methods described fall into four areas: chemical concentration and separation of impurities from uranium prior to analysis, concentration and separation of impurities from uranium by evaporation and condensation prior to analysis, direct excitation of impurities in U_3O_8, and the carrier distillation excitation of impurities in U_3O_8. Numerous carrier distillation methods and associated problems are discussed in detail. The effects obtained with different carrier materials, different electrode geometries, and different graphites are described. Important factors to be considered in the preparation of the U_3O_8 sample and in mixing it with the carrier are also presented. The use of internal standards versus timed exposures is compared. Experiences reported using direct-reading spectrometers and spectrographs are included. (auth)

38874 (NLCO-1001, pp 2.1-3) MASS SPECTROMETRIC DETERMINATION OF ^{236}U IN UF_6 SAMPLES USING THE DOUBLE-STANDARD INTERPOLATIVE METHOD. Ohlinger, R. D.; Hellmann, R. J. (National Lead Co. of Ohio, Cincinnati).

A method is described for the precise determination of the ^{236}U concentration in UF_6 samples. The assays are performed on a 12-inch, 90°, isotope-ratio mass spectrometer. Samples are prepared by fluorinating U_3O_8 to UF_6 using the CoF_3 technique. Results of this study indicate the limit of error for a single determination (95% C.L.) to be ±0.0010 wt % or lower at the 0.0160 wt % level. (auth)

38875 (NP-16798) APPLICATION DE L'ANALYSE PAR RADIOACTIVATION DOSAGE DU MANGANESE DANS LE BLE. (Application of Radioactivation Analysis to Determination of Manganese in Wheat). Soubeyrand, Roland (Grenoble Univ. (France). Faculte des Sciences). July 12, 1965. 35p. (In French). Dep.

Thesis.

The radioactivation method was applied to the detection of Mn deficiencies in wheat. The principle of radioactivation determination of Mn in plants was briefly developed. A complete map of the distribution of Mn was established for a mutant wheat and a control wheat. The evolution of the Mn concentration of a wheat cultivated in the laboratory and deprived of this element was followed. (J.S.R.)

38876 (ORNL-P-3261) CURRENT CAPABILITIES IN ANALYSIS OF TRACE SUBSTANCES: ELECTROANALYTICAL METHODS. Kelley, Myron T. (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 6p. (CONF-670720-1). Dep. CFSTI.

From 1st Annual Conference on Trace Substances in Environmental Health, Columbia, Mo.

Methods and applications of electrolytic conductivity, glass electrodes, voltammetry, chronopotentiometry, and coulometry for trace analysis are discussed. (M.C.G.)

38877 (PG-REPORT-789) ANALYTICAL METHOD FOR THE DETERMINATION OF COBALT IN 0.2 PERCENT ALUMINIUM ALLOY (E.D.T.A. TITRATION). Johnson, C. R.; Mellor, H. (United Kingdom Atomic Energy Authority, Sellafield (England). Production Group). 1967. 9p. Dep. CFSTI. UK 2s. 6d.

A sample of aluminum foil, containing 30 to 100 μg of cobalt, was dissolved in concentrated hydrochloric acid and transferred to an anion exchange column. Aluminium was eluted with concentrated hydrochloric acid, and then the cobalt was eluted with water. The pH of the cobalt eluate was adjusted to 5 and copper-EDTA complex solution added, followed by PAN indicator. An equal volume of acetone was added and the cobalt titrated using 0.002M EDTA. The end point was determined photometrically and the titer obtained graphically. (auth) (UK)

38878 (UCRL-Trans-10120) PROCESS FOR THE PREPARATION OF URANIUM NITRIDE. Naumann, Dieter; Heyne, Werner; Burk, Werner. Translated for Lawrence Radiation Lab., Univ. of California, Livermore, from German Patent 48,580. 8p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

A process for the preparation of uranium nitride, particularly uranium nitride particles having a spherical or nearly spherical shape, is presented. A uranium compound in the gaseous state, for example uranium tetrachloride, was reacted with gaseous ammonia at 1000 to 1400°C. The reaction was carried out in a fluidized-bed reactor charged with a "seed material" constituted of an irregular powder of a fissionable ceramic such as uranium oxide. As a result of the reaction, an adhering uranium nitride coating was deposited on the fissionable ceramic powder particles. When the fluidized bed was of sufficient thickness, these particles grew in size and became spherical in shape. The process can be employed as part of the reprocessing of nuclear fuel irradiated in reactors. (D.H.M.)

38879 USE OF EXTRACTION CHROMATOGRAPHY FOR IMPROVING YTTRIUM ANALYSIS SENSITIVITY TO RARE EARTH IMPURITIES. Zemskova, M. G.; Lebedev, N. A.; Melamed, Sh. G.; Saunkin, O. F.; Sukhov, G. V.; Khalkin, V. A.; Kherrmann, E.; Shmanenkova, G. I. (Joint Inst. for Nuclear Research, Dubna, USSR. State Scientific-Research and Planning Inst. of the Rare-Metals Industry, Moscow). Zavod. Lab., 33: 667-71(1967). (In Russian).

Apparatus and methods for the combined analysis of pure samples of Y with admixtures of rare earths from La to Ho were developed. Preliminary separation of the admixtures by the method of extraction chromatography guarantees an increase in the sensitivity of the determination by 50 to 100 times. Neutron activation of the rare earth concentrate with subsequent separation on ion exchange columns makes possible an increase in the sensitivity of the determination of the majority of the elements by 10^2 to 10^4 times. (tr-auth)

38880 ACTIVATION ANALYSES OF RUTHENIUM IN OSMIUM AND IN RHODIUM BY MEANS OF PHOTONUCLEAR REACTION. Oka, Yoshinaga; Kato, Toyoaki; Saito, Tatsuya (Tohoku Univ., Sendai). Nippon Kagaku Zasshi, 88: 866-71(Aug. 1967). (In Japanese).

Methods of photoactivation analyses were studied for the determinations of Ru in Os and in Rh. The irradiations were performed for 1 hr with 20-MeV bremsstrahlung radiation generated from a linear electron accelerator. Ru can be determined by measuring either the 0.340-MeV γ of ^{95}Ru or the 0.762 MeV γ of ^{95}Tc. The matrix Os or Rh was used as an internal monitor of the bremsstrahlung radiation dose to which the sample was exposed. The accuracy of the method was investigated by irradiating the mixtures of Ru and Os or Ru and Rh with known weight ratios. The activity ratios of ^{95}Ru to ^{185}Os were found to be proportional to the weight ratios of the Ru to Os. Similarly, a linear relation was obtained between the ratios of ^{95}Tc to ^{102}Rh activities and the ratios of the Ru to Rh weights. Relative standard deviations of less than ±5% were attained. Ru concentrations down to about 0.01% in Os or about 0.03% in Rh may be determined nondestructively by this method. (auth)

38881 ACTIVATION ANALYSES OF SEVERAL MIXED RARE EARTH ELEMENTS BY MEANS OF PHOTONUCLEAR REACTION. Oka, Yoshinaga (Tohoku Univ., Sendai); Kato, Toyoaki; Nagai, Iwao. Nippon Kagaku Zasshi, 88: 871-5(Aug. 1967). (In Japanese).

Nondestructive methods of analyses for Ce in La, Gd in Tb, and Tm in Er were developed based on the formation of the radioactive species induced by the (γ,n) processes in these elements. The irradiations were performed for 1 hr with 20-MeV bremsstrahlung radiation generated from a linear electron accelerator. CeO_2–La_2O_3, Gd_2O_3–Tb_4O_7, and Tm_2O_3–Er_2O_3 mixtures of known compositions were used for checking the accuracies of the methods by means of γ spectrometric measurements. La_2O_3 and Tb_4O_7 were favorable matrices for nondestructive determinations of CeO_2 and Gd_2O_3, respectively. A linear relation was attained between the photopeak yield of 0.166-MeV γ from ^{139}Ce and the CeO_2 content of the samples. CeO_2 in La_2O_3 down to about 5 μg can be determined by this method. Similarly, Gd_2O_3 in Tb_4O_7 down to about 2 μg can be determined by measuring the 0.363-MeV γ photopeak of ^{159}Gd. For Tm_2O_3 analysis, the matrix Er was used as an internal monitor of bremsstrahlung radiation dose rate, and the activity ratio of the ^{168}Tm(0.198 MeV γ) to ^{161}Er(0.826 MeV γ) was compared with a known weight ratio of Tm_2O_3 to Er_2O_3 in the sample. A content of 0.01% Tm_2O_3 in Er_2O_3 matrix may be determined by this method. (auth)

38882 THIN-LAYER CHROMATOGRAPHY OF INORGANIC IONS: QUANTITATIVE DETERMINATION OF URANIUM. Lesigang-Buchtela, Margrit; Buchtela, K. (Univ., Vienna. Osterreichische Hochschule, Vienna). Mikrochim. Acta, No. 4, 670-5 (July 1967). (In German).

Uranium was separated from interfering accompanying ions by means of thin layer chromatography and then determined by activation analysis. The ^{239}Np was measured gamma-spectrometrically. The application to materials containing uranium was demonstrated. (auth)

38883 SEPARATION, DETECTION, AND DETERMINATION OF URANIUM, THORIUM, BISMUTH, AND LEAD IN A DROP OF SOLUTION BY THE RING OVEN TECHNIQUE. Ghose, Animesh K.; Chatterjee, Robi; Dey, Arun K. (Univ. of Allahabad, India). Mikrochim. Acta, No. 4, 685-9(July 1967).

The separation of uranium, lead, bismuth, and thorium from each other in a drop of solution containing uranyl acetate, lead nitrate, bismuth nitrate, and thorium nitrate has been achieved, using the ring oven technique. The drop was taken on a circular filter paper, treated with 1 N HNO_3 and uranium was washed to the ring zone with n-butanol. Lead was next washed to the ring zone on another filter paper using 20% aqueous ethylenediamine hydrate. The spot was then treated with 1% aqueous sodium diethyldithiocarbamate and bismuth was transported to the ring zone on a third paper with ethyl acetate. Finally 0.5 N HNO_3 was employed to transfer thorium to the ring zone. The separated rings were then compared with standard rings prepared similarly to compute the amounts of the ions present. (auth)

38884 MICRODETERMINATION OF URANIUM(VI). Gupta, S. S.; Mukerjee, D. (Univ. of Lucknow, India). Mikrochim. Acta, No. 4, 763-7(July 1967).

A new method has been evolved for the separation and estimation of UO_2^{2+} from Cu^{2+}, Zn^{2+}, Ag^{+}, Pb^{2+}, Ga^{3+}, In^{3+}, Tl^{3+}, La^{3+}, Ti^{4+}, Zr^{4+}, and Th^{4+} with the sodium salt of benzilic acid as precipitating and chelating agent and n-butanol as solvent for solvent extraction. All these cations except UO_2^{2+} are precipitated by benzilic acid; UO_2^{2+} forms a deep yellow complex extractable by n-butanol. The uranium can be determined in the organic phase spectrophotometrically at 430 nm. The pH range over which the separation can be carried out is 2.6 to 4.0. Few anions and cations interfere. (auth)

38885 ISOTOPIC ANALYSIS OF OXYGEN BY OPTICAL SPECTROSCOPY. Ungureanu, C. (Inst. of Atomic Physics, Cluj). Isotopenpraxis, 3: 237-9(June 1967).

The isotopic analysis of oxygen (range of concentration: 1 to 31 at. % ^{18}O) by emission spectroscopy (O I 8446 Å line) by using a Fabry-Perot spectrometer with photoelectric recording of the spectral lines is described. The measuring error is within ±8% (for 1 at. % ^{18}O) and ±2% (for 31 at. % ^{18}O). The results are compared with those obtained by mass spectrometry. (auth)

38886 PHOTONEUTRON METHOD OF ISOTOPIC ANALYSIS OF HYDROGEN IN NATURAL WATERS. Khristianov, V. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Isotopenpraxis, 3: 235-7(June 1967). (In Russian).

A photoneutron method for determining the deuterium content in liquid samples is described. The neutrons to be measured are produced by the reaction D(γ,n)H. The method proposed is more simple and rapid than the densitometric ones, but has the same accuracy. The effects of Cd, B, and Cl in the sample on the results of measurements are discussed. (auth)

38887 DETERMINATION OF THE IMPURITIES AND INVESTIGATION ON THEIR DISTRIBUTION IN DIAMOND CRYSTALS OF VARIOUS DEPOSITS USING NEUTRON ACTIVATION ANALYSIS. Glazunov, M. P.; Kodochigov, P. N.; Orlov, Yu. L. (Inst. of Physical Chemistry, Moscow). Isotopenpraxis, 3: 231-5(June 1967). (In Russian).

The impurities in 45 diamonds from various deposits were determined. The following elements were found: Na, Mg, Al, Sc, Ti, Cr, Mn, Co, Cu, La, and Au. For the first time Sc, Co, La, and Au were determined. The distribution of some of the impurities in

the bulk of 6 crystals of different shape and coloration was studied. The maximum concentration of the impurities in all the crystals was found to be in a comparatively thin layer near the surface of the crystals. (auth)

38888 EFFICIENCY OF REFINING OF ACETIC ACID FROM INORGANIC IMPURITIES BY NORMAL FREEZING METHOD BY RADIOISOTOPIC TECHNIQUE. Knypl, E. T. (Chemical Works Oswiecim, Poland). Isotopenpraxis, 3: 190-2(May 1967).

Investigations on the efficiency of refining of acetic acid by the normal freezing method using radiotracer technique and neutron activation are presented. The equilibrium distribution coefficient for Zn^{2+} in CH_3COOH was determined; the same coefficient was also determined for Cl^- but with a lower degree of approximation and a "generalized" distribution coefficient for a set of ions was estimated by comparison of radioactivity of original and refined samples of acetic acid after neutron activation in nuclear reactor. (auth)

38889 APPLICATION OF VARIOUS METHODS IN ACTIVATION ANALYSIS FOR IRON AND COBALT. Bondy, Charles (Atome Industriel, Grenoble, France). Anal. Chim. Acta, 38: 579-80(Aug. 1967). (In French).

The method used for activation analysis of Fe and Co solutions of unknown concentrations, provided by the Commission for Establishment of Methods of Analysis of the French Atomic Energy Commission, are briefly described and the results obtained by the various methods compared. (J.S.R.)

38890 PRACTICAL EXPERIENCE IN OPERATION AND CONTROL USING A BETA-RADIOMETRIC ANALYZER AND POSSIBILITIES OF ITS USE IN DIFFERENT BRANCHES OF INDUSTRY. Schiller, Pavel (Comenius Univ., Bratislava). Jad. Energ., 13: 103-5(Mar. 1967). (In Czech).

A radiometric control method based on intensity measurement of beta radiation reflected by the substance being analyzed is described. Operational tests of the instrument in different industrial branches, predominantly in pharmacy, are discussed. Test results of the beta-recoil method in determination of ash in coal, the amount of unburned coal in fly ash, and the iron content in ores are considered. (auth)

38891 A STUDY OF THE COMPLEX FORMATION OF SCANDIUM WITH METHYLTHYMOL BLUE. Akhmedli, M. K.; Gambarov, D. G. (Azerbaydzhan State Univ., Baku). Zh. Anal. Khim., 22: 1183-5(Aug. 1967). (In Russian).

Conditions were studied for complex formation of scandium with methylthymol blue. The optimum conditions were pH = 2 and λ = 570 nm. The composition of the complex at pH 2 was found to be 1 : 1; the molar extinction coefficient (ϵ_{570} = 15,000) and the equilibrium constant of the complex forming reaction ($K_{equil} = 0.8 \times 10^{-4}$) were calculated. A method was suggested for determining scandium in pure salts and in silicates by means of methylthymol blue. (auth)

38892 ABSORPTION-SPECTROPHOTOMETRIC DETERMINATION OF CERIUM(III) IN SOLUTIONS OF ITS COMPLEX COMPOUNDS WITH ETHYLENEDIAMINETETRAACETIC AND NITRILOTRIACETIC ACIDS. Kirillov, A. I.; Poluektov, N. S. (Odessa Labs. of the Inst. of General and Inorganic Chemistry). Zh. Anal. Khim., 22: 1186-9(Aug. 1967). (In Russian).

It was found that on complex formation of cerium(III) with ethylenediaminetetraacetic and nitrilotriacetic acids the absorption band of cerium(III) in the ultraviolet region of the spectrum, which is considered to appear due to the $4f \rightarrow 5d$ electron transition, is shifted to the longer wave region. The maximum absorption of 253.6 nm is shifted to 282 nm for the first and to 295 nm for the second complex forming substance. A study was made of the effect of pH and the concentration of complex forming substances on the absorption spectra of cerium(III) complexes. A method was developed for the spectrophotometric determination of cerium in complexonate solutions. The sensitivity of the method is 1 μg/ml of cerium. (auth)

38893 THE APPLICATION OF SUBSTOICHIOMETRIC RADIOISOTOPIC DILUTION PRINCIPLES TO CONTROLLED-POTENTIAL COULOMETRY AND SOLVENT EXTRACTION. Landgrebe, A. R. (National Bureau of Standards, Washington, D. C.); McClendon, L. T.; Devoe, J. R.; Pella, P. A.; Purdy, W. C. Anal. Chim Acta, 39: 151-9(Oct. 1967).

Radioisotope dilution principles were applied to controlled-potential electrolysis and solvent extraction with dithizone for the determination of trace amounts of cadmium. A method was developed to verify whether or not the substoichiometric principle was obeyed. If the substoichiometric principle was not obeyed, analysis was still possible by means of calibration curves. In order to obtain independent verification of the series controlled-potential method and to establish a means of comparison with the radioisotope dilution technique a current integration procedure was also employed. A microtechnique was used to extend the sensitivity of the solvent extraction system for cadmium. Standard zinc spelter and high-purity zinc were analyzed for cadmium after separation by a method of standard addition. (auth)

38894 NEW DEVELOPMENTS IN RADIOGENIC ARGON DETERMINATION BY NEUTRON ACTIVATION ANALYSIS. Soroiu, M.; Cerei, M. (Inst. for Atomic Physics, Bucharest). Geochim. Cosmochim. Acta, 31: 1271-9(Aug. 1967).

New developments in radiogenic argon determination by neutron activation analysis resulting in a marked increase in the sensitivity and efficiency of the method are described. The use of a Toepler pump for introducing argon into quartz vials subjected to irradiation, as well as the treatment applied to these vials, resulting in a considerable reduction of the amount of argon-37 obtained from the $^{40}Ca(n,\alpha)^{37}Ar$ reaction, made possible the accurate estimation of the contaminating atmospheric argon. By this new technique of introducing argon into vials their volume could be reduced, allowing the simultaneous irradiation of eight vials — six samples and two standards — in a container of 40 mm external dia. The validity of this new variant of radiogenic argon determination was checked by comparing the results obtained on identical samples by this new technique and by conventional methods. The minimum quantity of radiogenic argon determined during the experiments was 2.0×10^{-8} g. The error in this case amounted to 2%. The minimum quantity of radiogenic argon that can be accurately determined by the method is stated to be 10^{-9} g. (auth) (UK)

38895 TRACE ELEMENT DETERMINATION BY ELECTROCHROMATOGRAPHIC RADIOMETRIC PRECIPITATION. Morse, Robert S.; Welford, George A.; Chiotis, Elias L. (Atomic Energy Commission, New York). Anal. Chem., 39: 1336-7(Sept. 1967).

A technique is described for the determination of microgram quantities of stable elements by electrochromatographic precipitation on a paper strip with a radioactively labeled precipitant. By utilizing a radioactive precipitant with an opposite charge to that of the stable element, precipitation on the strip occurred on contact, and the excess precipitant migrated toward the anode. A radioautograph was made to locate the element. Its area was cut from the paper strip, analyzed radiometrically, and the counting rate compared with an analytical curve. The sensitivity of the technique depends on the solubility of the compound of the element and the specific activity of the precipitant. As little as 0.1 μg of the alkaline earth elements as sulfates and phosphates or 0.1 μg of the rare earth elements as phosphates was determined with good reproducibility. Results are reported for Ba, Sr, Dy, Gd, Er, Eu, Tb, and Yb. (D.H.M.)

38896 INTERFERENCE FROM NATURAL RADIOACTIVITY IN NEUTRON ACTIVATION ANALYSIS FOR BISMUTH IN LEAD. De Boeck, R.; Adams, F.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 39: 270-2(Oct. 1967).

Naturally occurring ^{210}Bi can interfere with the ^{210}Bi formed by neutron activation from the $^{209}Bi(n,\gamma)^{210}Bi$ reaction. This isotope is present in variable concentration in recently fabricated lead as a result of the occurrence of uranium in lead ores. Through the manufacturing process, the series is interrupted at ^{210}Pb so that the ^{210}Bi activity decays with the half-life of ^{210}Pb, namely 21 years. The natural radioactivity of ^{210}Po was determined in lead so that the error in activation analysis for bismuth could be estimated. It appears that the disintegration ratios of ^{210}Po and ^{210}Bi are approximately the same. The sensitivity of activation analysis of bismuth through measurement of ^{210}Po can be increased by separating the bismuth from the lead after irradiation followed a separation of the ^{210}Po daughter ingrown from the total ^{210}Bi activity. Interference can also be minimized by increasing the neutron flux. (D.H.M.)

38897 STUDIES ON ESTIMATION OF ELEMENTS BY GAMMA IRRADIATION. Asai, Takuo; Azuma, Toshio (Radiation Center of Osaka Prefecture). Annu. Rep. Radiat. Center Osaka Prefect., 6: 115(Mar. 1966).

A method is described for the estimation of elements contained in insoluble materials by irradiating the materials in water with γ rays and then filtering. A sample of the water is evaporated on filter paper, and analyzed by neutron activation. (B.L.M.)

38898 SIGNIFICANCE OF ACTIVATION ANALYSIS IN MEDICAL SCIENCE. Kertesz, Laszlo (Coll. of Medicine, Debrecen, Hungary). Kiserletes Orvostudomany, 18: 627-34 (1966). (In Hungarian).

Activation analysis opens up new possibilities in the field of medical isotope research. A method is described in which the experimental system or a selected aliquot of sample is activated,

and the isotope formed in it is measured. Experimental results are compared with literature data for I_2 activation, and it is shown that under properly selected experimental conditions, reproducibility, automation, and sensitivity of activation analysis fully satisfy the requirements of a modern medical biological laboratory. 28 references. (JPRS)

38899 SPECTROPHOTOMETRY OF TRANS-PLUTONIUM ELEMENTS. Buijs, K. (EURATOM-CEN, Mol, Belg.). Chem. Weekbl., 61: 401-7(1965).

A survey is presented, with 28 references. The absorption spectra of AmO_2^{2+} in $HClO_4$ and aqueous Na_2CO_3 media are included. (Analytical Abstr.)

38900 ANALYSIS OF LANTHANUM HEXABORIDE. Foerster, W.; Zieger, M. Neue Huette, 10: 492-7(1965). (In German).

Various methods for analysing LaB_6 are reviewed, and several were tested. The titration of La^{3+} with EDTA solution (xylenol orange as indicator) was satisfactory. A gravimetric method, based on precipitation of La as oxalate and ignition to La_2O_3 was less precise, and amperometric titration with $Fe(CN)_6^{4-}$ was unsatisfactory. Boron was determined by titration with NaOH solution after oxidation to BO_3^- and separation of La by precipitation as carbonate. A satisfactory end-point was obtained, either visually (mannitol–phenol–phthalein method) or potentiometrically (platinum and calomel electrodes). (Analytical Abstr.)

38901 DETERMINATION OF THE ISOTOPIC COMPOSITION OF WATER BY THE FALLING-DROPLETS METHOD. Blaga, Liviu; Blaga, Lucia; Chifu, A. (Inst. of Atomic Physics, Cluj). Stud. Cercet. Fiz., 17: 765-73(1965).

A drop-formation apparatus that incorporates a capillary micropipette to permit direct determination of the drop volume and a mechanical control system to allow very fine adjustment of the liquid level in the pipette are described. The pipette is easily dismantled and washed. For determining the isotopic composition of water, the apparatus is coupled to a special cell filled with chlorobenzene–xylene for measuring the rate of descent of the droplets; continuous removal of the water with minimum solvent loss is achieved. The internal temperature is controlled to within ±0.001° by a double jacket. The device is sensitive to variations of 0.001 mole % of ^2H_2O over the range 1 to 3 moles %. (Analytical Abstr.)

38902 SEPARATION OF RADIO-STRONTIUM FROM MILK BY MEANS OF ION-EXCHANGE RESINS. Porcelli, G. Ann. Ist. Super. Sanita, 1: 335-41(1965). (In Italian).

Radio-strontium is separated from other elements by elution with ammonium citrate solution from a column of Dowex 50-X8 resin, the Sr ammonium citrate complex is destroyed with Na_2CO_3 and NaOH, and Sr is then determined by flame photometry. (Analytical Abstr.)

38903 DETERMINATION OF THE TRITIUM CONTAMINATION OF COLUMN-FILLING MATERIAL. Thiemann, A.; Jansen, J.; Hickert, J. (Kernforschungsanlage, Juelich, Ger.). Z. Anal. Chem., 215: 244-6(1966). (In German).

Columns of inorganic material used for separation of ^3H-labeled compounds may eventually retain substantial amounts of ^3H activity. This may be determined by heating column material with CuO or NiO at 700°C in O, passing the vapors over CuO at 700°C, condensing the H^3HO in traps cooled with brine and acetone–solid CO_2, washing out the traps with a scintillator solution in dioxane, and measuring the ^3H in a scintillation counter. (Analytical Abstr.)

38904 AIDS FOR WORK WITH RADIOACTIVE SUBSTANCES IN THIN-LAYER CHROMATOGRAPHY. Erismann, K. H. (Univ., Bern). J. Chromatogr., 20: 600-2(1965). (In German).

Apparatus is described for the simultaneous autoradiography of 1 to 20 TLC plates and for the subsequent location of radioactive spots on the plate using the autoradiogram. A suction device for removing individual spots from the plate is described. (Analytical Abstr.)

38905 NON-DESTRUCTIVE DETERMINATION OF HYDROGEN IN ORGANIC SOLVENTS BY THERMAL NEUTRON SCATTERING. Ishii, Daido; Hirose, Yoji; Mori, Hideo (Nagoya Univ., Japan). Bunseki Kagaku, 16: 686-91(July 1967). (In Japanese).

A rapid, nondestructive method based on the scattering process of neutrons by hydrogen nucleus was investigated for the determination of hydrogen content in organic solvents. The organic solvent samples were irradiated with a collimated thermal neutron beam from an Am–Be source, and the scattered thermal neutrons were measured by a BF_3-counter. The counting rate was linearly proportional to the content of hydrogen in the range 60 to 110 mg/ml with a 60 ml sample. Graphite blocks were used effectively as the thermal neutron reflector. The influences of coexisting carbon and oxygen atoms upon the calibration curve were not perceptible. (auth)

38906 CONTROLLED-POTENTIAL COULOMETRIC TITRATOR. Emura, Satoru; Okazaki, Shuji (Japan Atomic Energy Research Inst., Tokyo). Bunseki Kagaku, 16: 718-20(July 1967). (In Japanese).

A controlled-potential coulometric titrator and titration cells were devised for the control analysis of semi-microgram quantities of uranium(VI) in nitric acid solutions. The instrument consists of transistorized potentiostat, and the coulometer, utilizing a pulse counter with a simple voltage-frequency converter composed of DC current amplifier and UJT (unijunction transistor). Between the range of 1 to 5 mg of uranium(VI), the precision was found to be 0.4 per cent of relative standard deviation. (auth)

38907 EFFECT OF SOURCE TO TARGET GEOMETRY IN NEUTRON ACTIVATION. Crumpton, D. (Univ. of Aston, Birmingham, Eng.). Nucl. Instrum. Methods, 55: 198-200 (Sept. 1967).

The effect of a nonuniform extended neutron source on the activation equation was evaluated theoretically for small separations of source and sample. The general equation for the activation of a sample by a point source of neutrons offset from the axis was developed and solved using an Elliot 803 computer. The results, in nondimensional form, show the variation of the activation as the source is moved off axis and the source to sample distance is varied. The effect of varying the sample thickness is also calculated. (auth)

38908 SPECTROPHOTOMETRIC DETERMINATION OF TIN IN METALS AND ALLOYS. Luke, C. L. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Anal. Chim. Acta, 39: 404-6(Nov. 1967).

The spectrophotometric MIBK-phenylfluorone method of determining tin in steel was simplified by isolating the tin by solvent extraction as the iodide. By using the extraction it was possible to dispense with the sulfide separation, the double carbamate extraction, and the use of oxalate and peroxide as complexing agents in the color development with phenylfluorone. The method proved to be applicable to the analysis of highly alloyed steels and to many nonferrous metals and alloys, including Ni, Co, Mn, Cd, In, Zn, Al, and Mg. For a variety of reasons the metals Ge, Sb, Se, Te, Pb, Cu, Bi, Ti, U, and Th could not be analyzed. (D.H.M.)

38909 OXIDATION OF CERIUM(III) TO CERIUM(IV) USING A MIXTURE OF HOT CONCENTRATED PERCHLORIC AND SULFURIC ACIDS. Knecht, L. A. (Univ. of Cincinnati). Anal. Chim. Acta, 39: 349-55(Nov. 1967).

The oxidation of cerium(III) to cerium(IV) using a hot concentrated mixture of perchloric and sulfuric acids was shown to be quantitative. Optimum conditions for the oxidation are described. Complete removal of chlorine, an interfering decomposition product of boiling perchloric acid, was achieved by purging the concentrated acid solution with nitrogen before dilution with water. The presence of sulfuric acid was essential; the chief role of sulfuric acid apparently was to stabilize the cerium(IV) as a sulfatocerate complex. (auth)

38910 DIRECT READ-OUT SYSTEM FOR FAST NEUTRON ACTIVATION ANALYSIS FOR OXYGEN IN STEELS. Fujii, I.; Muto, H. (Tokyo Shibaura Electric Co., Ltd.). Anal. Chim. Acta, 39: 329-33(Nov. 1967).

Fast-neutron activation is useful for rapid determinations of oxygen in iron and steel, but the conventional calculations are tedious. A direct read-out system is described so that results are immediately available. (auth)

38911 ACTIVATION DETERMINATION OF IMPURITIES PRESENT IN TUNGSTEN. EXAMPLES OF APPLICATION TO THE LAMP INDUSTRY. Eychenne, M. (Faculte des Sciences, Toulouse); Bayle, Pierre; Blanc, Daniel; Laverlochere, Jean; Le Strat, Jean. Chim. Anal. (Paris), 49: 355-60(July 1967). (In French).

After activation of the metal by thermal neutrons, the separations are done by means of ion exchange resins. On each eluate the γ spectrometry and sometimes the β spectrometry after calibration furnish the nature and concentration of each impurity. An activation by 14 MeV neutrons was needed in order to dose oxygen and silicon. The method was applied to the study of the influence of impurities present in tungsten filaments on the functioning of incandescent lamps containing iodine vapor. (auth)

38912 OXYGEN DETERMINATION BY NUCLEAR METHODS. Miller, F. J. Isotop. Radiat. Technol., 4: 237-43(Spring 1967).

Oxygen determination by activation analysis and other nuclear methods is reviewed. The development of the compact 14-MeV neutron generator and its commercial availability have made its

use for oxygen determination very nearly competitive with conventional methods in specific applications. Other radiochemical methods of analysis discussed are determination of oxygen in oxide films, analysis for tracer ^{18}O, and the indirect determination of oxygen in water. (P.C.H.)

38913 SPECTROPHOTOMETRIC DETERMINATION OF THE RARE EARTHS EMPLOYING ALUMINON. Sinha, S. N.; Sangal, S. P.; Dey, A. K. (Univ. of Allahabad, India). Chem. Anal., 56: 59-60(July 1967).

Details are presented for the use of Aluminon (the triammonium salt of aurintricarboxylic acid) in the spectrophotometric determination of the trivalent rare earths and yttrium. Results are tabulated. (J.G.B.)

38914 GRAVIMETRIC DETERMINATION OF LANTHANIDES IN THEIR ACETYLACETONATES BY DIRECT IGNITION TO OXIDE. Richardson, Mary Frances; Sands, Donald E.; Wagner, William F. (Univ. of Kentucky, Lexington). Chem. Anal., 56: 65(July 1967).

Direct ignition of the diketone chelates of the lanthanides to their oxides was studied as a short cut in the determination of a lanthanide in its compounds. The quantitative results of the direct ignition of lanthanide acetylacetonates agreed well with those by tedious acid digestion, conversion to the oxalate, and subsequent ignition. (J.G.B.)

38915 β COLUBRINE AS INDICATOR FOR CERIUM(IV) TITRATION OF IRON(II), HEXACYANOFERRATE(II), HYDROQUINONE, URANIUM(IV) AND MOLYBDENUM(V), AND DICHROMATE TITRATION OF MOLYBDENUM(V). Sastry, T. P.; Sastry, P. S.; Dayanand, E. L. R.; Reddy, K. A. N. (Reginal Engineering Coll., Warangal-Kazipet, India). Chem. Anal., 56: 66-7(July 1967).

Good quantitative results were obtained in the cerium titrations of iron, hexacyanoferrate, hydroquinone, uranium, and molybdenum, and in the dichromate titration of molybdenum when β-colubrine was used as the indicator. (J.G.B.)

38916 DIRECT SPECTROMETRY DETERMINATION OF Dy, Eu, Gd, AND Sm IN HIGH-PURITY THORIUM DIOXIDE. Nelms, J. R.; Vogel, R. S. (Mallinckrodt Chemical Works, St. Charles, Mo.). Appl. Spectrosc., 21: 242-5(July-Aug. 1967).

A spectrometric method is described for the direct determination of Dy, Eu, Gd, and Sm in the ppM range in ThO_2. The method, based on a carrier-distillation technique, utilizes AgCl as a carrier and Nd as an internal standard. Direct-current arc excitation in an atmosphere of 80% Ar–20% O_2 prevents formation of cyanogen band spectra and thereby permits the use of sensitive lines in the regions normally obscured by cyanogen bands. The method fulfills the requirements of precision and sensitivity for specification analysis of reactor-grade ThO_2 with a time saving of approximately 60%, as compared to conventional methods involving chemical separation. (auth)

38917 NONDESTRUCTIVE NEUTRON ACTIVATION ANALYSIS WITHOUT USING GAMMA SPECTROMETRY. Rakovic, Miloslav (Charles Univ., Prague). Chem. Listy, 61: 709-17 (June 1967). (In Czech).

A review of the literature (34 references) indicates that, whenever it is feasible, identification of radionuclides formed by activation by physical methods other than gamma spectrometry is less time-consuming and requires less expensive apparatus. The method used most frequently is graphical analysis of the decay curves, by means of which two or three nuclides may be determined provided their half-lives are sufficiently different. Complex decay curves may sometimes be analyzed mathematically. For some elements the high-energy beta may be determined with suitable filters, but the method is not recommended in many cases. A third method is measurement of the predominant activity, which may be used when the other activities are very low. (TTT)

38918 IMPROVED METHODS OF RADIOMETRIC ANALYSIS BASED ON THE ISOTOPIC EXCHANGE REACTION. Ikeda, Nagao; Amano, Sadayo (Tokyo Kyoiku Univ.). Radioisotopes (Tokyo), 16: 317-22(July 1967).

Improved methods of analysis based on application of isotopic exchange are proposed. The methods are classified as: the direct isotopic-exchange method, the reverse isotopic-exchange method, the double isotopic-exchange method, and the two-step isotopic-exchange method. The nonradioactive sample is analyzed by the first or second methods and the radioactive sample is analyzed by the second, third, or fourth methods. The principles and mathematical calculations of these methods were verified experimentally in the determination of iodide ions using the $I^-(aq) - I_2$ (in CCl_4) exchange system. (auth)

38919 APPLICATION OF REVERSED-PHASE COLUMN CHROMATOGRAPHY TO THE DETERMINATION OF TUNGSTEN IN STAINLESS STEELS BY ACTIVATION ANALYSIS. Espanol, Carlos E.; Marafuschi, Ana Maria (Univ., Buenos Aires). J. Chromatogr., 29: 311-15(July 1967).

Reversed-phase partition chromatography was used after irradiation to isolate tungsten from unwanted major components of steel. Polytrifluorochloroethylene (Kel-F) was used as an inert support for tri-n-octylamine (TNOA). The anionic metal complexes were retained on the top of the chromatographic column while the element which did not form anionic complexes were quickly eluted. Results from the analysis of various stainless steel samples show that the Kel-F–TNOA columns were suitable for the isolation and determination of tungsten, and subsequently cobalt in stainless steels. The time required for the method was about three hours including irradiation time. (D.H.M.)

38920 SUBSTOICHIOMETRIC DETERMINATION OF TRACES OF GOLD BY RADIOACTIVE ISOTOPE-DILUTION ANALYSIS. Beardsley, D. A.; Briscoe, G. B.; Ruzicka, J.; Williams, M. (Univ. of Aston, Birmingham, Eng.). Talanta, 14: 879-86(Aug. 1967).

A radioactive isotope-dilution method for the determination of traces of gold has been developed. It is based on the solvent extraction of gold diethyldithiocarbamate from 0.5N sulphuric acid containing ascorbic acid, using a substoichiometric amount of zinc diethyldithiocarbamate in chloroform. The separation was applied to the analysis of gold-doped semiconductor-grade silicon and of gold-bearing ores. Amounts of gold down to 5×10^{-7} g/20 ml of test solution can be determined. (auth) (UK)

38921 DETERMINATION OF URANIUM IN ELECTRO-REFINED PLUTONIUM BY A COMBINED ION-EXCHANGE AND X-RAY FLUORESCENCE TECHNIQUE. Hayden, J. A. (Dow Chemical Co., Golden, Colo.). Talanta, 14: 721-9(July 1967).

In the method described uranium is separated from plutonium by adsorption on an anion-exchange resin from a concentrated hydrochloric acid solution and is eluted from the resin, collected on a disc of cation-exchange paper, and determined by x-ray fluorescence. The lower limit of detection is 2 μg of uranium, and 50 μg may be determined with a recovery of 98% and a standard deviation of 3.2 μg. In plutonium metal, 19 ppM of uranium were found, with a standard deviation of 2 ppM (6 results). (auth) (UK)

38922 INSTRUMENTAL ACTIVATION ANALYSIS OF VEGETABLE TISSUE. Steinnes, E. (Institutt for Atomenergi, Kjeller, Norway). Talanta, 14: 753-8(July 1967).

A nondestructive method for the determination of bromine, manganese, phosphorus, potassium, sodium, and zinc in plant tissue by neutron activation and gamma spectrometry is described. Phosphorus and potassium were determined also by beta-counting. The method should be especially attractive for determination of manganese and zinc. (auth) (UK)

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Refer also to abstracts 39562, 39646, 39699, 39700, 40599, and 40719.

38923 (AI-CE-68) HEAVY WATER ORGANIC COOLED REACTOR. MELTING POINTS, TRANSITION ENERGIES, AND SPECIFIC HEATS OF POLYPHENYL REACTOR COOLANTS. Mandel, H. (Atomics International, Canoga Park, Calif. Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.). Aug. 15, 1967. Contract AT(38-1)-430. 25p. Dep. CFSTI.

Differential scanning calorimetry, a relatively new quantitative technique for making direct calorimetric measurements, was applied to studies of the melting behavior, transition energies, and specific heat of polyphenyls. The apparatus was used to determine melting points and heats of fusion of the major constituents of polyphenyl coolants, namely, biphenyl and ortho-, meta-, and para-terphenyl. The melting characteristics of two synthetic terphenyl binaries similar to proposed HWOCR coolants (ortho-meta isomer ratios of 2:1 and 1:2) were studied with respect to the effect of the high boiler (HB) fraction of the radiolytic and pyrolytic decomposition products and of para-terphenyl on the melting transition range. The effect of HB addition on the two binary mixtures is both time and concentration dependent in that the observed crystallinity of the samples decreases with increased HB addition, and increases with time. The addition of para-terphenyl to both binary mixtures, with and without HB, increases their final melting point. The calorimetric capabilities of the instrument were also utilized in measurement of the specific heats of solid biphenyl, ortho-, and para-terphenyl. (auth)

38924 (COO-1695-3) A KINETIC AND REACTION MECHANISM STUDY OF THE FORMATION AND DECOMPOSITION OF THE URANYL ION IN ORGANIC MEDIA. Quarterly Progress Report No. 1. Shohet, J. L. (Wisconsin Univ., Madison). June 15, 1967. Contract AT(11-1)-1695. 6p. Dep. CFSTI.

The quantum yield for photochemical reduction of uranyl nitrate hexahydrate in propionaldehyde with a 435 mμ mercury band was determined at 25°C. The quantum yield for the reduction of the uranyl nitrate was found to be 0.01. A design for a precision solution calorimeter is described. Improvements incorporated into the instrument are a thin-walled Dewar flask; a thermistor sensor in combination with a Mueller Bridge and voltage amplifier; and certain design features that more effectively isolate the reaction chamber from the constant-temperature surroundings. A two-compartment electrolytic cell was designed and operated using ethyl alcohol–uranyl acetate electrolyte and platinum wire helixes as electrodes. When one half of the unit was illuminated with a sun lamp, a potential of about 0.3 volt developed after a short induction period. An investigation of the complexation of 2-amino-2-deoxygluconic acid with uranium(VI) was made. From spectrophotometric measurements it appears that uranium(VI) formed a complex with 2-amino-2-deoxygluconic acid with maximum stability at pH = 12. (D.H.M.)

38925 (IS-T-182) HEMISPHERICAL SPECTRAL EMITTANCE OF SELECTED RARE EARTH OXIDES. McMahon, William Raymond (Ames Lab., Iowa). May 1967. Contract W-7405-eng-82. 59p. Dep. CFSTI.

Thesis.

The hemispherical spectral emittances for the sesquioxides of yttrium, samarium, gadolinium, erbium, thulium, and ytterbium are given for five wavelengths in the visible portion of the spectrum over a temperature range of 1400 to 3000°K. A reflectance technique incorporating a carbon arc image furnace and a standard of reflectance is used in the determinations. The emittance of zirconium dioxide is determined by the same method and used to check the validity of the method. (auth)

38926 (NP-16957) THERMAL RELAXATION PROCESSES IN GASES. VIBRATIONAL RELAXATION IN CO_2–D_2O MIXTURES. Shields, F. Douglas; Burks, James Alton (Mississippi Univ., University). Aug. 15, 1967. Contract Nonr 3078(01). 18p. CFSTI.

Sound absorption and velocity measurements were made in CO_2–D_2O mixtures at 300, 400, and 500°K. Results show that D_2O is from 1/3 to 1/8 as efficient as H_2O in de-exciting the bending mode vibration of CO_2 in a molecular collision. The collision efficiency of D_2O for de-exciting CO_2 decreases with temperature at an even greater rate than does that of H_2O. The large difference between D_2O and H_2O invalidates the chemical affinity explanation of effect of H_2O on CO_2. An approximate semi-classical calculation of the transition probability indicates that it is possible to attribute the relaxation to an interchange between the vibration of the CO_2 and the rotation of the H_2O or D_2O. (auth)

38927 (NYO-3608-4) RELATIVE CATION MOBILITIES IN MOLTEN SALT MIXTURES. Preliminary Report No. 1. Tenney, Albert A.; Laity, Richard W. (Rutgers–The State Univ., New Brunswick, N. J. School of Chemistry). 1967. Contract AT(30-1)-3608. 22p. Dep. CFSTI.

The applicability of some models and the importance of such factors as ion size, cation polarizability, and London forces to the relative mobility of cations is being studied. Silver halide–alkali halide mixtures were chosen for the study. Temperature control, electrolysis circuits, measurement of variables, electrode and cell design, analysis of salt mixtures, and materials and procedure are discussed. (M.C.G.)

38928 (ORNL-4126) MECHANISMS OF SORPTION OF MOLECULAR IODINE. Davis, R. J. (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 31p. Dep. CFSTI.

Based on a detailed study of a selected literature, a classification of the mechanisms of sorption of iodine in a reactor containment is suggested. The important parameters for each mechanism are presented, and illustrations of how these surface chemistry parameters can be incorporated with mass transfer equations are given. Specific research programs are recommended. The six mechanisms are: chemisorption on bare metal; monolayer adsorption with dissociation on dry oxides; diffusion-controlled reactions with oxide-coated metal; absorption into water or aqueous solutions; adsorption on a rapidly forming corrosion film; and sorption from a damp atmosphere. (auth)

38929 (ORNL-P-3203) THERMAL CONDUCTIVITIES OF ^{90}Sr HEAT SOURCE MATERIALS. Ketchen, E. E.; McHenry, R. E. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 13p. (CONF-670714-4). Dep. CFSTI.

From 2nd International Symposium on Nucleonics in Aerospace, Columbus, Ohio.

The thermal conductivities of SrO, Sr_2TiO_4, and $SrTiO_3$ (of a composition that simulates these compounds prepared from nuclear fission fuels waste) are reported. The thermal conductivities were measured using a comparator apparatus, which was altered to evaluate several factors necessary to establish a procedure for measurement of the thermal conductivities of radioactive heat source fuels. The errors in the reported values are assessed and a procedure for high-power-density radioactive samples is described. (auth)

38930 (RFP-922) DISSOLUTION OF PLUTONIUM OXIDE. Molen, Garrel F. (Dow Chemical Co., Golden Colo. Rocky Flats Div.). Aug. 29, 1967. Contract AT(29-1)-1106. 20p. Dep. CFSTI.

The dissolution rate of plutonium oxide as a function of its specific surface area and the mean crystallite size is described. The effect of the solid-to-liquid ratio is measured in both a nitric acid–calcium fluoride solvent system and in a hydrochloric acid–stannous chloride solvent system. (auth)

38931 (LA-tr-67-76) ACTIVITY OF UCl_3 IN THE EUTECTIC LiCl–KCl MELT. Knacke, O.; Krahe, J.; Mueller, F. Translated for Los Alamos Scientific Lab., N. Mex., from Z. Phys. Chem. (Frankfurt), 50: 91-104(1966). 21p. Dep. CFSTI. JCL $2.60 fs, $0. 83 mf.

The activity of UCl_3 was determined by emf measurements in the cell Ag/U/LiCl–KCl–UCl_3/LiCl–KCl–AgCl/Ag. At uranium contents up to 0.5 mol % UCl_3 at 450 to 650°C the activity of the UCl_3 was approximately equal to its mole fraction with pure liquid UCl_3 as the reference state. The UCl_3 was generated in the melt itself by anodic dissolution of a uranium rod. The activity coefficient, $f^0_{sol.}$ can be calculated as: RT ln $f^0_{sol.}$ = 10,850 – 10.21T and lg $f^0_{sol.}$ = 2372/T – 2.23. (M.C.G.)

38932 TRACER STUDY ON CATALYTIC HYDROGEN EXCHANGE REACTIONS OVER NICKEL CATALYST. Guczi, L.; Tetenyi, P. (Inst. of Isotopes, Budapest). Isotopenpraxis, 3: 184-7(May 1967).

In heterogeneous catalysis it is important to know the reactivity of C–H bonds in hydrocarbon molecules. Experiments were performed to obtain information about the exchange reaction of adsorbed hydrogen with methane and ethylene. In order to reduce the probability of forming products that contain more than one tritium atom, hydrogen labeled with ^3H with low activity was used. (auth)

38933 DICYCLOPENTADIENYLTECHNETIUM HYDRIDE. Fischer, E. O.; Schmidt, M. W. (Technische Hochschule, Munich). Angew. Chem. Int. Ed. Engl., 6: 93(Jan. 1967).

Dicyclopentadienyltechnetium hydride, $Tc(C_5H_5)_2H$, in 14% yield, and not the dimeric dicyclopentadienyltechnetium, $[Tc(C_5H_5)_2]_2$, was obtained from the reaction of technetium tetrachloride with cyclopentadienylsodium in tetrahydrofuran (THF) and in the presence of sodium tetrahydridoborate. Cyclopentadienylsodium, NaC_5H_5 (10.5 g), was added to a suspension of $TcCl_4$ (3.9 g) in THF (60 ml) at –50°C. After warming to 20°C, $NaBH_4$ (1.0 g) was added to the purple reaction mixture, which was then stirred at 50°C for 10 hr. Evaporation of the solvent and sublimation of the residue at 40 to 60°C/10^{-2} mm gave a yellow solid. Resublimation and recrystallization from toluene gave golden-yellow, pure platelets. Dicyclopentadienyltechnetium hydride is very sensitive to air, but thermally stable. The solid, which melts without decomposition at 150°C, is readily soluble in benzene and toluene but less so in hexane. The molecular weight was found osmometrically in benzene to be 225 (calculated 230.2). (BBB)

38934 USES OF INERT RADIOACTIVE GASES IN THE INVESTIGATION OF SOLIDS. Zhabrova, G. M.; Shibanova, M. D. (Moscow Inst. of Physical Chemistry). Usp. Khim., 36: 1406-26(Aug. 1967). (In Russian).

Theoretical data on emanation methods are reviewed and methods for injection and measuring inert radioactive gases are discussed. Emanation as a function of the specific surface of solids was analyzed. The uses of inert radioactive gases for studying phase transitions, crystal structure alterations, and particle mobility and dimensions are reviewed. The emanation method for investigation of thermal disintegration and interactions of solids, and separation of inert radioactive gases during chemical sorption and catalytic processes on the surfaces of solids are discussed. (88 references.) (R.V.J.)

38935 ON THE MECHANISM OF INTERACTION OF URANYL IONS WITH ARSENAZO III. Tserkovnitskaya, I. A.; Bykhovtsova, T. T. (Leningrad State Univ.). Zh. Anal. Khim., 22: 1201-9 (Aug. 1967). (In Russian).

The complex formation between uranium(VI) and arsenazo(III) in acid solutions was studied by a polarographic method. It was

found that uranium(VI) forms 1:1 and 1:2 complexes with arsenazo (III) in acid solutions. The first complex was soluble and the second complex was a fine-crystalline precipitate. The stability constants of the two complexes were determined. It was shown that on complex formation in the uranium(VI)–arsenazo(III) system both of the functional arsono groups are reactive. (auth)

38936 FINE STRUCTURE OF ISOTOPICALLY LABELED AMINO ACIDS DETERMINED BY ION EXCHANGE CHROMATOGRAPHY. Klein, Peter D.; Szczepanik, Patricia A. (Argonne National Lab., Ill.). Anal. Chem., 39: 1276-81(Sept. 1967).

The chromatographic mobilities of 13 tritium-labeled and 23 radiocarbon-labeled amino acids, representing 11 different amino acids, were measured relative to the unlabeled form and to each other on ion exchange columns. Within a given amino acid, each of the isotopic forms had a mobility distinctly different from the others and that could be determined with considerable precision. There was a strong correlation between the increase in retention volume of radiocarbon-labeled amino acids and the position of the isotope, being maximal in the carboxyl position. Tritium substitution in the 3 position also increased the retention volume, while other tritium locations decreased the retention of the amino acid. Secondary interactions between the isotopic forms during chromatography were revealed by the separation factors between ^{3}H and ^{14}C forms in the presence and absence of added carrier amino acid. (auth)

38937 COMPLEXES OF URANIUM(VI) WITH OXIDES OF DITERTIARY PHOSPHINES. Sandhu, Sarjit Singh; Sandu, Satinder Singh (Punjabi Univ., Patiala, India). Chem. Ind. (London), No. 33, 1405-6(Aug. 19, 1967).

Complexes of bisbiphenylbutyl- and bisbiphenylethylphosphine oxides with uranyl chloride, bromide, nitrate, acetate, etc. were prepared. These complexes precipitate when solutions of the reactants in n-butyl alcohol are mixed. The complexes are almost insoluble in most organic solvents, but slightly soluble in nitrobenzene, in which they behave as nonelectrolytes. The stretching frequencies for P = 0 and U = 0 bonds in these complexes are tabulated. The results are not in agreement with those of others. A notable feature is the lowering of the stretching frequency of the U = 0 bond by 20 and 30 cm^{-1} in uranyl compounds after complexing, this being due to lowering of d π–pπ interaction. (UK)

38938 HYDROGENATION OF ETHYLENE ON METALLIC CATALYSTS. PART 7. QUALITATIVE VERIFICATION OF THE RATE-DIAGRAM THEORY OF HORIUTI BY DEUTERATION OF LIGHT ETHYLENE ON EVAPORATED NICKEL FILM. Miyahara, Koshiro (Hokkaido Univ., Sapporo). J. Res. Inst. Catal., Hokkaido Univ., 14: 144-52(Dec. 1966).

The theory of Horiuti concerning the rate determining step change for the reaction $H_2 \rightarrow H + H$ to $C_2H_5 + H \rightarrow C_2H_6$, at the optimum temperature, with rise of temperature was qualitatively verified by observation of the initial rate of deuteration of light C_2H_5 catalyzed by evaporated Ni films and D_2 distribution in reacted H_2 and C_2H_5. The Ni film was a used one on which the concurrent dissociative absorption of C_2H_6 was practically suppressed at low temperatures. Temperature dependence of the kinetic isotopic effect, i.e., a ratio of hydrogenation rate of light C_2H_5 by protium to that by D_2 was observed on the same Ni film at 0.1 mm Hg total pressure, resulting in qualitative agreement with the conclusions of the rate-diagram theory. Deuteration on carbided Ni film resulted, in distinction to in the case with a used film, in dilution of D_2 gas by equilibrated protium atoms at temperatures below and above the optimum, revealing a large pressure dependence of its heat of activation at temperatures below the optimum and a temperature-independent kinetic isotopic effect in the same temperature range, which was larger than that on used film throughout the range. These results and the previous ones, i.e., the finding of extremely small hydrogenation rates and adsorbed amounts of H_2 as compared with in the case of used film, suggested another mechanism of hydrogenation of C_2H_5 on carbided film than that applicable for the rate-diagram theory on used film. (BBB)

38939 NEUTRON-DIFFRACTION STUDY OF LaF_3. Choi, Chang-sun (Army Materials Research Agency, Watertown, Mass.). New Phys. (Korea), 7: No. 1, 37-9(June 1967).

The structure of lanthanum trifluoride was investigated by neutron diffraction. The observed data suggest that the crystal has hexagonal symmetry with a mirror plane parallel to the crystallographic c-axis. Using a $P6_3$ cm space group, which is proposed by nuclear magnetic resonance investigation, the atom positions are determined by Fourier summation and the least-squares refinement with anisotropic temperature factor. (auth)

38940 REDUCTION OF SAMARIUM AND ERBIUM ON A DROPPING MERCURY ELECTRODE. Kovalenko, P. N.; Azhipa, L. T.; Tsygankov, E. M.; Evstifeev, M. M. (Rostov State Univ., Rostov-on-Don, USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 10: 613-16(1967). (In Russian).

The mechanism of samarium and erbium reduction on a dropping mercury electrode was studied using an oscillographic polarograph with trielectrode thermostatic cell. The analysis was done with samarium and erbium chlorides with a 0.1 n solution of lithium chloride as background. The reduction process of samarium was of a step-line character with the first step $Sm^{3+} + e \rightarrow Sm^{2+}$ and the second $Sm^{2+} + 2e \rightarrow Sm^{0}$. Three electrons participate in the erbium reduction $Er^{3+} + 3e \rightarrow Er^{0}$. The magnitude of the maximum current of Sm^{3+} and Er^{3+} was determined as a function of the pH of the solutions. The diffusion and transfer coefficients for the elements examined were determined. (R.V.J.)

38941 HYDROGEN BRIDGE ASSOCIATION AND VAPOR ISOTOPE EFFECTS OF VARIOUS DEUTERATED METHYLAMINES. Wolff, H.; Hoepfner, A. (Univ., Heidelberg). Ber. Bunsenges. Phys. Chem., 71: 461-6(July 1967). (In German).

The vapor pressure isotherms of mixtures of CD_3NH_2 and CD_3ND_2 with n-hexane were measured at temperatures between +20 and –55°C, together with the pressure differences of undiluted CH_3NH_2, CH_3ND_2, CD_3NH_2 and CD_3ND_2. From the isotherms dimerization constants, dimerization energies, solvation energies, and vaporization energies of CD_3NH_2 and CD_3ND_2 were calculated. The differences that exist between CD_3ND_2 and CD_3NH_2 are in agreement with results found for the compounds that are not deuterated in the methyl group. Furthermore, from these measurements vapor pressure quotients were calculated for the pure amines and the solutions in n-hexane. Their comparison shows that for pairs of N-deuterated and non-N-deuterated amines there occurs simultaneously an inverse isotope effect on the vapor pressure ($p^D > p^H$) that is only slightly dependent on the amine concentration and the temperature, and a normal isotope effect on the vapor pressure ($p^D < p^H$) that is markedly dependent on the amine concentration and the temperature. The occurrence of the normal effect only at sufficiently low temperatures and sufficiently high concentrations proves its causal relation with association. Its occurrence on deuteration only of one amino-group suggests moreover that it can be explained in terms of the differences between hydrogen-bond and deuterium-bond association. (auth)

38942 FREE ENERGIES OF FORMATION OF THORIUM SULFIDES FROM SOLID-STATE EMF MEASUREMENTS. Aronson, S. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. J. Inorg. Nucl. Chem., 29: 1611-17(July 1967). (BNL-10839).

Thermodynamic information in the thorium–sulphur system was obtained from measurements on solid electrochemical cells at temperatures of 825 to 925°C. The cells employed were of the following types: Th, $ThF_4|CaF_2|ThF_4$, ThS, Th_2; Th, $ThF_4|CaF_2|ThF_4$, Th_2S_3, ThS; Th, $ThF_4|CaF_2|ThF_4$, Th_7S_{12}, Th_2S_3; and Th, $ThF_4|CaF_2|ThF_4$, ThS_2, Th_7S_{12}. Free energies, entropies, and enthalpies of formation of the sulphides were calculated from the data. Lattice parameter measurements were made on thorium monosulphide to investigate the possibility of nonstoichiometry in this phase. The results of these measurements are discussed. (auth) (UK)

38943 DENSITY OF LIQUID NEPTUNIUM HEXAFLUORIDE. Friec, B. (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 29: 1804-5(July 1967).

The density of liquid neptunium hexafluoride was measured at 56 to 76°C. The methods used are described, and the values determined are tabulated. (P.C.H.)

38944 IMPACT OF LOW-COST NUCLEAR POWER ON THE CHEMICAL INDUSTRY. Butler, W. S. (Dow Chemical Co., Midland, Mich.). Chem. Eng. Progr., Symp. Ser., 63: No. 71, 8-10(1967).

Heavy chemical manufacture frequently requires large quantities of process steam as well as electric power. These total energy requirements by heavy chemical manufacture have often made on-site power generation feasible using fossil fuels. Nuclear energy cost could be more independent of location, and location could thus serve rather than dictate plant economics. Since the fuel cost of nuclear power will approach zero, or even become negative in the case of the fast breeder reactor, the concept of steam being cheaper than electric heat may fall through the cost of distributing steam lines. Freedom from all forms of air pollution will be of interest to the manufacturers of high-purity chemicals. (auth)

38945 ECONOMICS OF A DUAL CYCLE CHEMONUCLEAR NITROGEN FIXATION PROCESS. Beller, Morris; Epel, Lester G.; Steinberg, Meyer (Brookhaven National Lab., Upton, N. Y.). Chem. Eng. Progr., Symp. Ser., 63: No. 71, 31-44(1967).

An economic and design study for the production of fixed N_2 is presented, which utilizes both direct fission fragment energy and indirect thermal energy from a nuclear reactor. The results in-

dicate that the method can prove competitive with conventional N_2 fixation techniques, provided that G values of at least 6.0 can be achieved and that plant capacities are in the order of 3,000 tons/day fixed N_2. (auth)

38946 AN ECONOMIC STUDY OF THE PRODUCTION OF AMMONIA AND OTHER CHEMICALS WITH THE USE OF ELECTRICITY FROM A NUCLEAR DESALINATION REACTOR COMPLEX. Blanco, R. E.; Holmes, J. M.; Salmon, Royes; Ullmann, J. W. (Oak Ridge National Lab., Tenn.). Chem. Eng. Progr., Symp. Ser., 63: No. 71, 18-30(1967). (ORNL-P-2591).

A survey of twenty industries indicated that production of NH_3 and other fertilizers could probably use large blocks of power most efficiently at a large nuclear-desalination site. The production of H_2 and NH_3 fertilizer via electrolysis was compared with that from the conventional steam-methane reforming process. Factors studied included power cost, natural gas cost, production rate, return on investment, type of electrolytic cell, by-product oxygen credit, and transportation cost. Using electrolytic cells that operate at very high current densities, ammonia can be produced for $39/ton with power at 2.5 to 3.0 mills/kWh. Such power costs are obtainable on an incremental basis from commercial light-water reactors. It is possible that foreign customers may find such systems attractive in competition with purchased NH_3, which may cost $40/ton or more delivered. Large advanced reactors producing power at 1.6 mills/kWh appear to be capable of producing NH_3 competitive in the United States (assuming a credit for by-product oxygen) with NH_3 produced by the conventional steam-methane reforming process, using natural gas at 29 to 33¢/million Btu's. The average U.S. industrial natural gas price in 1963 was 34¢/million Btu's. (auth)

38947 IR SPECTRA OF URANYL ION ATTACHED TO ION EXCHANGE RESINS. Ohwada, K. (Japan Atomic Energy Research Inst., Tokyo). J. Inorg. Nucl. Chem., 29: 1802-3(July 1967).

The work described was undertaken to determine accurately the U–O bond lengths from the ir spectra of the uranyl ion attached to some ion exchange resins. From the asymmetric stretching frequency, the force constant (K′) was determined, and the U–O bond length was then calculated using Badger's rule. (auth) (UK)

38948 CHROMATOGRAPHY ON ION EXCHANGE PAPERS. THE BEHAVIOR OF SOME METAL IONS ON CARBOXYLIC EXCHANGERS. Lederer, M. (CNR, Rome). J. Chromatogr., 29: 306-8(July 1967).

The chromatographic behavior of metal ions on two carboxylic ion exchange papers, carboxymethyl-cellulose paper (Whatman CM-50) and the Amberlite Wa-2 paper, was investigated. Buffers with equal molarities of sodium acetate and acetic acid were used as eluents. Uranyl ions precipitated in the buffer. The R_F values obtained with various molarities of eluents are tabulated. F_e(III) and Zr(IV) gave diffuse comets on Whatman CM-50 paper. Beryllium and aluminum gave double spots on the Amberlite WA-2 paper Most other ions gave elongated spots on the Whatman CM-50 paper and very compact sharp spots on the Amberlite WA-2 paper. (D.H.M.)

38949 PERIODIC POSITION OF LANTHANUM AND ACTINIUM. Dash, H. H. (Variety Children's Hospital, Miami, Fla.). J. Inorg. Nucl. Chem., 29: 1811-12(July 1967).

Villar (J. Inorg. Nucl. Chem. 28: 25(1966)) presented a number of multi-termed equations for calculating the atomic number (Z_p) of an element from its position in the periodic chart. His main thesis, which forms a suggested modification of the chart, is the exclusion of La and Ac from the group of elements constituting the first members of the d-transition series, the scandium group. Alternative methods of calculation which do not support this conclusion are discussed. (auth) (UK)

38950 COUNTERCURRENT DISTRIBUTION OF LABELED ANOMERIC METHYL ARABINOSIDES AND METHYL α-D-MANNOSIDE. Marshall, Lawrence M.; Walker, W. Paul; Gunn, Joycelynn A.; Panton, Lucy (Howard Univ. Coll. of Medicine, Washington, D. C.). J. Chromatogr., 29: 103-7(July 1967).

The isotope effect observed during the countercurrent distribution of arabinose-1-^{14}C did not appear with the methyl glycoside of this labeled pentose. This observation along with the difference in the symmetry of plots for methyl α-D-mannoside and D-mannose were considered in the discussion of such isotope effects. (auth)

38951 SYNTHESIS OF THORIUM SULFITE COMPOUNDS. Golovnya, V. A.; Molodkin, A. K.; Tverdokhlebov, V. N. Zh. Neorg. Khim., 12: 2075-85(Aug. 1967). (In Russian).

Physicochemical studies were made of the system $Th(NO_3)_4$ – M_2SO_3–H_2O (where M is Na^+, K^+, and NH_4^+) and the synthesis of thorium sulfite compounds. Thorium aquasulfite, and hydroxysulfite complexes with the ratio from 0.5 to 4.0 were studied. The percentage composition of simultaneously present sulfite and sulfate groups in thorium compounds was determined. (R.V.J.)

38952 METHOD OF PREPARING STRONTIUM TITANATE. (to U.S. Atomic Energy Commission). French Patent 1,341,046. Sept. 16, 1963. Priority date Oct. 31, 1961, United States.

A solution containing $^{90}Sr(NO_3)_2$ and $Ti(NO_3)_3$ (mol. ratio 1 : 1.01; pH ≤ 0.5) is boiled to precipitate H_4TiO_4 and cooled to 35°C. H_2O_2 (100% excess) is added and the pH raised to 11. The combined precipitates of H_4TiO_4 and $^{90}SrO_2$ are filtered, dried, and heated to 400 to 800°C, which gives $^{90}SrTiO_3$. This compound is useful as a heat source in a thermo-electric nuclear battery. (NPO)

38953 BORAZINES SUBSTITUTED BY CYCLIC ORGANIC GROUPS AND THEIR METHOD OF PREPARATION. (to Farbenfabriken Bayer A.G.). French Patent 1,431,245. Jan. 31, 1966. Priority date Mar. 14, 1964, Germany.

A method for the preparation of substituted borazines, which may be used for the preparation of neutron-absorbing polymers, is described. (NPO)

38954 SYNTHESIS OF POTENTIAL RADIATION-PROTECTIVE COMPOUNDS: INVESTIGATION OF THE SYNTHESIS OF MERCAPTOMETHYLAMINE HYDROCHLORIDE, THE SYNTHESIS OF ALPHA-AMINO BUNTE SALTS, AND RELATED COMPOUNDS. Abdou-Sabet, Sabet. College Park, Md., Univ. of Maryland, 1966. 116p.

Thesis.

Simple compounds such as mercaptomethylamine hydrochloride, bis(aminomethyl)disulfide dihydrochloride and S-aminomethylthiosulfuric acid, which may be of potential biological activity especially in the field of radioprotective compounds, were synthesized. Bis(phthalimidomethyl)disulfide was prepared from the known N-bromomethylphthalimide with sodium disulfide. Similarly, bis(α-phthalimidoethyl)disulfide was obtained from N-(α-bromoethyl)phthalimide, which was prepared from N-(α-ethoxyethyl phthalimide. Partial alkaline hydrolysis of bis(phthalimidomethyl)disulfide afforded bis(o-carboxybenzoylaminomethyl)disulfide, which on acid hydrolysis gave six products including the two new compounds bis(aminomethyl)disulfide dihydrochloride and phthalimidomethyl aminomethyl disulfide hydrochloride. Also, hydrazinolysis of bis(phthalimidomethyl)-disulfide gave bis(aminomethyl)disulfide dihydrochloride. Hydrogenolysis of bis(aminomethyl)disulfide dihydrochloride undoubtedly gave mercaptomethylamine hydrochloride, which rearranged, however, to give bis(aminomethyl)sulfide dihydrochloride and hydrogen sulfide. The hydrogenolysis of phthalimidomethyl aminomethyl disulfide hydrochloride produced by-product N-thiolmethylphthalimide, expected from the cleavage of the S-S bond, as well as bis(aminomethyl)sulfide dihydrochloride. The structure of bis(aminomethyl)sulfide dihydrochloride was confirmed by independent synthesis from bis(phthalimidomethyl)-sulfide, which was obtained in the reaction of N-bromomethylphthalimide with sodium hydrogen sulfide. Several approaches to the synthesis of S-aminomethylthiosulfuric acid were investigated. In one synthetic sequence, the N-trifluoroacetyl group was used for protection of the nitrogen. Trifluoroacetamide condensed with chloral to give N-(α-hydroxy-β,β,β-trichloroethyl)-trifluoroacetamide, which was converted to the corresponding chloro derivative with PCl_5. N-(α,β,β,β-Tetrachloroethyl)trifluoroacetamide was dehydrohalogenated with triethylamine to give the imine, which added hydrogen sulfide to form N-(α-thiol-β,β,β-trichloroethyl)trifluoroacetamide. However, the mercapto derivative added to the intermediate imine to give mostly bis(trifluoroacetamido-β,β,β-trichloroethyl)sulfide. In an alternate route, S-detritylation of trifluoroacetamido-β,β,β-trichloroethyl triphenylmethyl sulfide (prepared from the N-(α,β,β,β-tetrachloroethyl)-trifluoroacetamide and triphenylmethyl mercaptan) was investigated. S-Detritylation with mercuric acetate in alcohol, however, produced N-(α-ethoxy-β,β,β-trichloroethyl)-trifluoroacetamide; detritylation in acidic media did not occur. 2-Mercaptoethylamine hydrochloride was found to produce 2-aminoethanethiosulfuric acid by treatment with pyridine sulfur trioxide. However, when mercaptomethylamine hydrochloride (prepared in situ) was allowed to react with pyridine sulfur trioxide, only black oils were obtained. N-Bromomethylphthalimide reacted with sodium thiosulfate to give S-phthalimidomethylthiosulfuric acid sodium salt, which on hydrazinolysis gave N-aminophthalimide, a by-product unprecedented in hydrazinolysis and in disagreement with the accepted mechanism. Hydrazinolysis of S-phthalimidomethylthiosulfuric acid pyridinium salt afforded the hydrazinium salt, or unidentified products and hydrogen sulfide. Self-cleavage of the hydrazinium salt did not afford any desired products. Simultaneous introduction of the two electronegative groups (-S_2O_3H and -NH_2) on a single carbon atom was attempted, by allowing aldehydes and ketones to react with $(NH_4)_2S_2O_3$, but the reaction was accompanied by extensive decomposition. The

reaction of benzalaniline with thiosulfuric acid (prepared in situ by the addition of HCl to $Na_2S_2O_3$) gave aniline tetrathionate and benzaldehyde. When freshly prepared thiosulfuric acid (in methanol at −70°) was added to benzalaniline, an inorganic substance, aniline sulfate, benzaldehyde, and brown oils were obtained. (Disser. Abstr.)

38955 OMAGIU ACAD. PROF. RALUCA RIPAN. (Homage to Academy Professor Raluca Ripan). Bucharest, Editura Academiei Republicii Socialiste Romania, 1966. 627p. (In Several Languages).

Eighty-two papers presented at a meeting to honor Acad. Prof. Raluca Ripan on June 29, 1964, are included. Separate abstracts were prepared for 3 papers. (M.C.G.)

For abstracts of individual papers see: 38956, 38969, and 39006.

38956 THE INFLUENCE OF LIGAND FIELDS ON THE ENERGY LEVELS OF LANTHANIDES AND OF URANIUM(IV). Jezowska-Trzebiatowska, B.; Bukietynska, K.; Legendziewicz, J. (Univ. of Warsaw). pp 613-18 of Omagiu Acad. Prof. Raluca Ripan. Bucharest, Editura Academiei Republicii Socialiste Romania, 1966. (In French).

The influence of ligand fields on the energy levels of electronic $5f^2$ ions was studied by means of the absorption spectra of uranium(IV) and praseodymium(III). As a measure of this influence the experimental magnitude of ζ_{3p} was accepted, and the relation of this magnitude to the spin-orbital coupling constant was shown. On the basis of this magnitude, the order of the ligands was obtained according to the increase of the relativistic nephelauxetic effect. (tr-auth)

Radiation and Nuclear Chemistry

Refer also to abstracts 39142, 39662, 39711, and 40564.

38957 (ANL-7327) A CALCULATION ON THE EFFECT OF NONHOMOGENEITY ON THE DETERMINATION OF THE RATE CONSTANT OF A BIMOLECULAR, SECOND-ORDER REACTION. Sauer, Myran C. Jr. (Argonne National Lab., Ill.). May 1967. Contract W-31-109-eng-38. 5p. Dep. CFSTI.

In pulse-radiolysis experiments, where a beam of electrons is absorbed by a sample, thereby producing chemical transients, the concentration of the transients is often not uniform, due to attenuation and scattering of the electron beam as it passes through the sample. A calculation is presented which shows that, for a chemical transient that disappears by a bimolecular, second-order reaction, wide variation in initial concentration throughout the reaction cell has a negligible effect on the slope of a plot of the reciprocal of concentration vs time, which is contrary to intuition. (auth)

38958 (COO-1618-1) GRADIENT ELUTION ANION EXCHANGE CHROMATOGRAPHY IN HOT-ATOM STUDIES. Anselmo, Vincent C. (New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry). Aug. 1, 1967. Contract AT(11-1)-1618. 11p. Dep. CFSTI.

Gradient elution anion exchange chromatography was applied to the separation of various oxidation states of phosphorus oxyanions produced in thermal-neutron-irradiated orthophosphates, orthophosphites, or hypophosphites. Production of a logarithmic gradient is discussed and the results using several different gradients are illustrated. (auth)

38959 (COO-1618-2) IDENTIFICATION OF COMPLEX PHOSPHATES IN NEUTRON IRRADIATED PHOSPHORUS OXY-ANION SALTS. Anselmo, Vincent C.; Sanchez, Ernest (New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry). Aug. 1, 1967. Contract AT(11-1)-1618. 6p. Dep. CFSTI.

An attempt was made to identify the complex phosphates previously identified as being formed in thermal neutron-irradiated orthophosphates, orthophosphites, and hypophosphites. Gradient elution anion exchange chromatography, under different conditions, was the analytical method used. It was concluded that the species are of high molecular weight and contain more than 14 or 15 phosphorus atoms. (auth)

38960 (COO-1618-4) NITROGEN CONTAINING PHOSPHORUS OXY-ANIONS IN NEUTRON IRRADIATED HYPOPHOSPHITES WHEN DISSOLVED IN LIQUID AMMONIA. Anselmo, Vincent C. (New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry); Sanchez, Ernest (Eberline Instrument Corp., Santa Fe, N. Mex. Radiochemistry Lab.). Aug. 1, 1967. Contract AT(11-1)-1618. 8p. Dep. CFSTI.

Ammonium and calcium hypophosphites were irradiated with thermal neutrons, quenched and stored in liquid nitrogen, dissolved in liquid ammonia, and separated by anion exchange. Quantitative isothermal annealing data are presented on ammonium hypophosphite. Calcium hypophosphite was virtually insoluble in liquid ammonia, so quantitative data are lacking. Data indicated that present in the solution are nitrogen-containing phosphorus oxyanions of unknown compositions that are formed by a reactor between a fragment in the solid and the liquid ammonia. (M.C.G.)

38961 (JAERI-4041) PRODUCTION OF ^{35}S AND PREPARATION OF ITS INORGANIC LABELLED COMPOUNDS. A REVIEW OF METHODS. Shikata, Eiji (Japan Atomic Energy Research Inst., Tokyo). July 1965. 7p. (In Japanese). Dep.

Methods of producing carrier-free ^{35}S from neutron-irradiated potassium chloride and methods of preparing inorganic labeled compounds of ^{35}S are reviewed. The quantity of sulfur compound used as labeled compound and the usefulness for further synthesis-process was considered. Sulfite, thiosulfate, sulfide, thiocyanate, and elementary sulfur were the sulfur compounds considered. (auth)

38962 (AD-628301) INVESTIGATION OF THE ROLE OF FREE RADICALS IN THE ACETALDEHYDE POLYMERIZATION PROCESS IN THE SOLID PHASE UNDER γ IRRADIATION. Pshezetskii, V. S.; Tupikov, V. I. Translated from Vysokomol. Soedin., Geterotsepnye Vysokomol. Soedin., 213-19(1963). 14p. (FTD-TT-65-978). CFSTI. JCL $1.60 fs, $0.80 mf.

The EPR method was used to investigate the processes of formation and recombinations of the radicals that form in crystalline acetaldehyde under γ-irradiation. It was established that in the dose range from 0.1 to 10 MRAD, the radical concentration corresponds in order of magnitude to the concentration of polymer chains. Radical recombination takes place abruptly at temperatures coinciding with the "critical" temperatures determined by the thermographic method. It was found that monomolecular rupture takes place at small radiation doses; at larger doses (0.2 MRAD and up), chain rupture takes place in accordance with a bimolecular law. Ultraviolet radiation initiates polymerization of crystalline acetaldehyde. The nature of the radicals that appear corresponds perfectly to that of the radicals formed on exposure to γ radiation; the concentration of the radicals corresponds to that of the molecular chains. The results obtained justify the assumption that polymerization of crystalline acetaldehyde proceeds by the radical mechanism when initiated by either ionizing radiation or ultraviolet light. (auth)

38963 (JPRS-42164) INDUSTRIAL MANUFACTURE OF HEAVY WATER. Zhavoronkov, N. M.; Zakodynskii, K. K. Translated from Kernenergie, 4: 893-904(1961). 28p. (TT-67-32794). CFSTI.

In a review of the industrial manufacture of heavy water, characteristics of the most important separation methods suitable for production of heavy water (electrolysis, chemical isotope separation, and fractional distillation) are discussed. A survey of the plants constructed, under construction, and planned for the production of heavy water is presented. (63 references.) (D.H.M.)

38964 EFFECT OF GAMMA IRRADIATION ON SOLID-STATE CHLORINATION OF POLYETHYLENE. Dzhagatspanyan, R. V.; Korolev, B. M.; Romanskii, I. A.; Zetkin, V. I. Vysokomol. Soedin., Ser. A, 9: 1195-1200(June 1967). (In Russian).

Chlorination of low-pressure polyethylene in the solid state caused by ^{60}Co γ-irradiation was carried out. Kinetic treatment of the reaction was attempted in the amorphous phase of the polymer. (auth)

38965 CHEMICAL TRANSFORMATION OF POLYVINYL ACETATE AT ITS RADIATION-THERMICAL MODIFICATION. Larin, V. A.; Markova, Z. A.; Yakovenko, V. I.; Bakh, N. A. (Inst. of Electrochemistry, Moscow). Vysokomol. Soedin., Ser. A, 9: 1221-7(June 1967). (In Russian).

Radiothermal transformations of polyvinyl acetate were studied using gas-liquid chromatography and ir spectra. When samples were irradiated with 4-MeV electrons, acetic acid, methane, hydrogen, carbon monoxide, and minor amounts of carbon dioxide were identified as the main products. In all stages of pseudo-oxidation in an oxygen atmosphere at 200 to 250°C and pyrolysis in an oxygen-free atmosphere at 400 to 800°C, the processes of deacylation and dehydrogenation to the polyconjugation system were predominant. The hydrogen content was similar to poly-ring hydrocarbons with developed conjugation system. The polyconjugated system developed as a result of rupture of alternating substituents showed better electrical characteristics than the polyethylene system. (auth)

38966 EFFECT OF POLYFUNCTIONAL MONOMERS ON RADIATION CROSSLINKING OF POLYETHYLENE. Egorova, Z. S.; Karpov, V. L.; Leshchenko, S. S.; Mitrofanova, L. V.;

Finkel, E. E. (Scientific-Research Physical-Chemical Inst., Moscow. Scientific-Research Inst. of the Cable Industry, Moscow). Vysokomol. Soedin., Ser. A, 9: 1451-8(July 1967). (In Russian).

The effect of triallyl cyanurate (TAC), diallyl maleate (DAM) and allyl methacrylate (AMA) on polyethylene (PE) crosslinking and polyfunctional monomer (PFM) introduction were studied by means of extraction and IR spectroscopy. All tested PFM was shown to effectively sensitize radiation PE crosslinking in air (except DAM) and in an inert gas atmosphere their action was effective at doses not higher than 50 MRAD. Not only PFM addition to polymer radicals occurred during irradiation but partial polymerization also occurred. The PFM efficiency depended to a considerable extent on the method of their introduction into PE. Thermal treatment caused polymerization of PFM and decreased its efficiency. (auth)

38967 EPR METHOD FOR INVESTIGATION OF SULFUR REACTIONS WITH RUBBER DURING RADIOLYSIS FOLLOWED BY LIGHT ILLUMINATION. Kozlov, V. T.; Tarasova, Z. N.; Klinshpont, E. R.; Milinchuk, V. K.; Dogadkin, B. A. (Scientific-Research Inst. of the Tire Industry, Moscow). Vysokomol. Soedin., Ser. A, 9: 1541-7(July 1967). (In Russian).

The ESR spectra of some mixtures of rubber and sulfur, irradiated at −196°C, showed the presence of radicals with g = 2.003 and g = 2.027. The phenomenon is expressed to a higher extent the lower the T_g of the rubber. When the temperature was increased the concentration of the radicals with g = 2.027 was increased and attained a maximum at T_g. The absence of sulfur widened the radicals decay region to temperatures below T_g. Light illumination caused the radicals decay to be more intense from the red to ultraviolet region and in the presence of sulfur. The results are explained by the reaction of radicals and ions, stabilized by the radicals the latter act as mobile species. (auth)

38968 STUDIES ON AZULENES. I. THE ACTION OF RADIANT RAYS ON AZULENES. THE γ-RAY IRRADIATION ON GUAIAZULENE. Otani, Yasushi; Ogura, Isao; Hirayama, Hiroshi; Kyotani, Masahiro; Takeda, Giichi (Konan Kako Co., Ltd., Osaka). Yakugaku Zasshi, 87: 242-6(1967). (In Japanese).

Isoöctane solutions and crystals of guaiazulene were γ-irradiated with 10^2- to 10^8-R doses from ^{60}Co, and their absorption spectra were measured in the uv region. An aqueous solution of sodium guaiazulene-3-sulfonate was also similarly irradiated and changes in uv spectra were measured. There was no general change in uv absorption but the visible spectrum of the irradiated isoöctane solution showed changes, of arithmetic mean type of about 40, in the mean value of total absorption in the absorption × 10^3 value and about 12 in the fluorescence spectra, with the 10^8-R irradiation dose. Thus, in general, the absorption values changed in an arithmetic or geometric series up to a certain limit with the irradiation dose. The ir and nmr spectra of guaiazulene crystals irradiated with γ rays showed practically no changes from those of nonirradiated guaiazulene. (BBB)

38969 POLAROGRAPHIC INVESTIGATION OF γ-IRRADIATED AQUEOUS SOLUTIONS OF INSULIN. Brdicka, R.; Fojtik, A.; Spurny, Z. (Inst. of Physical Chemistry, Prague. Inst. of Nuclear Research, Prague). pp 163-6 of Omagiu Acad. Prof. Raluca Ripan. Bucharest, Editura Academiei Republicii Socialiste Romania, 1966.

The effects of γ-irradiation on aqueous solutions of insulin were studied by measurement of the height of the polarographic double-wave due to the catalytic effect of disulfide groups contained in the molecule of insulin. The analysis of experimental data showed that the course of polarographic inactivation of these groups follows a first order reaction after a certain induction period elapsed. (auth)

38970 SOME EFFECTS OF γ-IRRADIATION IN POLYTETRAFLUOROETHYLENE FILLED WITH CARBON BLACK. Fock, J. (Polytechnic Inst. of Brooklyn). J. Polym. Sci., Part B, 5: 635-40(Aug. 1967).

Homogeneous mixtures of polytetrafluoroethylene (Teflon) and carbon black were irradiated under vacuum at 10^{-5} Torr in a ^{60}Co γ source at a dose rate of 2 × 10^5 R/hr. Differential thermal analyses and mechanical tests were carried out. While 10 to 25% pure carbon black improved the tensile strength up to 25 MRAD, as little as 5% carbon black containing 2% volatiles caused pronounced deterioration after irradiation. Tensile strength decreased slightly in annealed material filled with pure carbon black, whereas it increased in the quenched material. Mechanisms are suggested for the observed increase in crystallinity. (P.C.S.)

38971 EFFECT OF TEMPERATURE ON THE YIELDS OF THE PRECURSORS OF HYDROGEN IN THE RADIOLYSIS OF ETHANOL. Basson, R. A. (Atomic Energy Board, Pretoria). J. Chem. Soc. A, No. 7, 1179-82(1967).

The yields of solvated electrons and hydrogen atoms, the precursors of hydrogen in the radiolysis of ethanol, were determined as a function of temperature. $G(H_2)$ and $G(H_2)_m$ were independent of temperature, but $G(e^-)$ increased and G(H) decreased with decreasing temperature. This result was interpreted as the increasing probability of sub-excitation escape from the field of the parent ion with increasing dielectric constant. A plot of $G(e^-)$ against ϵ was in good agreement with previous work on other alcohols, and in qualitative agreement with theoretical predictions. (auth) (UK)

38972 THE RADIATION CHEMISTRY OF n-PROPANOL. PART I. FORMATION OF THE MAJOR PRODUCTS. Basson, R. A.; van der Linde, H. J. (Atomic Energy Board, Pretoria). J. Chem. Soc., A, No. 7, 1182-6(1967).

The major products of the radiolysis of pure liquid propanol are hydrogen, propionaldehyde, and hexane-3,4 diol. The initial yields are $G(H_2) = 4.4$, $G(EtCHO) = 2.9$, and $G(EtCHOH)_2 = 1.5$, but the hydrogen and aldehyde yields decrease with increasing dose. This effect has been shown to be due to scavenging of a precursor of hydrogen by the aldehyde. Studies with solutes have shown that hydrogen has as its precursor solvated electrons and hydrogen atoms which may be scavenged, and also that part of the yield of this product is due to molecular processes. Yields and rate constants of the intermediates were determined. (auth) (UK)

38973 CORRELATION OF ESR SPECTRA OF IRRADIATED POLY(GLYCOL METHACRYLATE) AND POLY(METHYL METHACRYLATE). Szocs, F. (Inst. of Polymers, Slovak Academy of Science, Bratislava); Ulbert, K. J. Polym. Sci., Part B, 5: 671-6(Aug. 1967).

Polymers of ethylene glycol bismethacrylate were x-irradiated under vacuum with a dose of 10^6 rads and ESR spectra were studied. Results are in agreement with previous ESR literature on polymethylmethacrylate. Due to the retarding influence of crosslinking on the velocity of decay, another radical appeared to be coincident with the fifth line of the nine-line spectrum. Mechanisms are suggested for the changes of the ratio of the intensities of the spectral lines during the decay at constant temperature. (P.C.S.)

38974 BRANCHING IN POLY(METHYL METHACRYLATE) OBTAINED BY γ-RAY IRRADIATION. Blumstein, Alexandre (Lowell Technological Inst., Mass.). J. Polym. Sci., Part B, 5: 687-90(Aug. 1967).

Radiation effects on methyl methacrylate monomers were studied using a high dose of ^{60}Co γ radiation. The resulting high-intensity polymers were hard, yellow, did not swell appreciably, and dissolved with great difficulty in toluene. Branching during the polymerization appeared to occur during the early period of irradiation. This suggests that the distinction between crosslinking and degrading polymers may not be as drastic as asserted by many authors. (P.C.S.)

38975 ASSIGNMENT OF THE METHYLENE PROTON SIGNALS AND ESTIMATION OF THE MESO-TO RACEMIC METHYLENE RATIOS IN POLYACRYLONITRILES. Yoshino, Tsuneo; Kenjo, Hideki; Kuno, Kiyoshi (Toyo Rayon Co., Kanagawa, Japan). J. Polym. Sci., Part B, 5: 703-9(Aug. 1967).

NMR spectra of x-polymerized polyacrylonitriles were compared with those of polymers prepared by a radical process. Elimination of geminal proton coupling proved effective for authentic assignment of the methylene signals and reliable estimation of the meso-to-racemic methylene ratio of a polymer with diad signals close to each other. The ratio in polyacrylonitrile was disposed of using this method. (P.C.S.)

38976 INITIAL PRODUCTS FROM RADIOLYSIS OF WATER AND THEIR REACTIONS WITH DISSOLVED SUBSTANCES. Pikaev, A. K.; Ershov, B. G. (Saratov State Univ., USSR). Usp. Khim., 36: 1427-59(Aug. 1967). (In Russian).

A brief review is given on the free radical theory of the radiolysis of water. Hydrated electrons, hydrogen atoms, OH radicals, HO_2 radicals, oxygen atoms, water excitation, molecular products of H_2 and H_2O_2, and the maximum yields of water disintegration are discussed. (472 references.) (R.V.J.)

38977 RADIOCHEMISTRY OF WATER, AQUEOUS SOLUTIONS, AND SIMPLE ORGANIC COMPOUNDS. Minder, Walter (Eidgenoessische Gesundheitsamt, Bern). pp 39-182 of Handbuch der Medizinischen Radiologie, Vol. 2, Part 1. Berlin, Springer Verlag, 1966. (In German).

The overall field of radiation chemistry including analytical methods and irradiation techniques is surveyed. Special attention is given to some aqueous inorganic systems, including radiochemistry of H_2O, primary reactions of H_2O, and radiation oxidation of $FeSO_4$, as well as to some radiochemistry of simple organic compounds. (438 references). (TSS)

38978 RADIOINDUCED REACTIONS IN POLYOXYMETHYLENE. Fischer, H.; Langbein, W. (Deutsches Kunststoff-In-

stitut, Darmstadt, Ger.). Kolloid-Zh., 216-17: 329-36(Mar.-Apr. 1967). (In German).

Radioinduced reactions in high polymers were investigated by electron irradiation, at a dose rate of 15 MRAD/min and doses of up to 400 MRAD, of polyoxymethylene diacetate $CH_3COO(CH_2O)_n COCH_3$. Delrin 500, molecular weight 31,000, was irradiated in vacuo at 14°C by 1-MeV electrons. The radioinduced reactions were studied by measurements of solubility, by ir spectroscopy, nmr spectroscopy, and gas chromatography. In agreement with findings for polyethylene and polyethylene oxide, the direct cross linking reaction occurs, and, additionally, two degradation reactions. These degradation reactions showed the influence of the oxygen atoms in the molecular chain, which was more pronounced in polyoxymethylene than in polyethylene oxide, corresponding to the higher content of oxygen in polyoxymethylene. (BBB)

38979 SOFT WOOD GETS TOUGH. Mod. Plast., 44: 96-7; 184(Mar. 1967).

Development of a radiopolymerization process for hardening wood is discussed. The process is based on impregnating ordinary, low-density wood with a plastic monomer and polymerizing it in the wood by radiation to produce a new material with all of the properties of a high-density hardwood. The product is considered superior to untreated wood in all respects except 2: it is heavier, since 1 lb of monomer goes into every pound of wood treated, and it will not take nails. Wood parts to be treated are first impregnated with monomer and then exposed to a ^{60}Co source to effect polymerization. The wood-plastic composite (WPC) develops a hardness reading 4½ times that of untreated wood. It has a permanent gloss that is self-renewing. It has improved weatherability, durability, and dimensional stability. Properties reported to be improved by both methods include hardness; compressive, bending, and shear strengths; toughness; water and moisture absorption resistance; decay, fungus, and chemical resistance; machineability; and, with the addition of suitable additives, fire retardancy. (BBB)

38980 THE RADIATION CHEMISTRY DATA CENTER. Ross, Alberta B. (Univ. of Notre Dame, Ind.). J. Chem. Doc., 7: 34-6(Feb. 1967).

A description is given of the scope, function, and facilities of the Radiation Chemistry Data Center, a specialized data center under the chemical kinetics program of the National Standard Reference Data System, and supported jointly by the Division of Technical Information of the Atomic Energy Commission and by the National Bureau of Standards. Radiation chemistry data include rates of elementary processes and yields of products and intermediates formed by the action of ionizing radiation on definable chemical systems. The Center was established to bring together all information of radiation chemistry and provide a means of making selected and evaluated data readily available to scientists throughout the world. All possible sources of data from radiation chemistry are being collected. The information is indexed by keywords, and the numerical values reported for measurements of chemical and physical properties of the irradiated systems are recorded. The data file is not a manual operation but future plans include the transfer of data to machine-searchable form. Sources of recording errors are discussed. (BBB)

38981 STUDIES ON X AGENT. LII. DEMONSTRATION OF THE ACTIVATION OF WATER BY THE APPARENT CHANGE OF ITS TRANSPARENCY. Moriyama, Hideo (Shonan Hygiene Inst., Kamakura, Japan). Yokohama Med. Bull., 18: 5-14(Feb. 1967).

To determine the effect of this biological agent on water the transmittance change of an absorption cell, used with the Leitz photometer, filled with water was examined. It was confirmed that, in addition to an effect on the glass surface of the cell, the water contained in the cell was altered, as shown by a transmittance change. Radiation passing through the activated glass was thought to be given a special energy, with which water was activated. Radiation activated in such a manner affected the photoelectric cell in the photometer, resulting in a temporary apparent change of transmittance. The photoelectric cell reacted to the activated radiation more strongly than to the normal light. The activated state of the water seemed more lasting than that of the glass surface. However, the acivated state was lost after exposure to strong light. The frosted glass surface was activated more frequently than the water, insofar as the activation was demonstrable by the transmittance change. (BBB)

38982 MIXED-BASE PLASTIC SCINTILLATORS. Bezuglyi, V. D.; Mukhina, S. A. (All-Union Scientific Research Inst. of Monocrystals, Kharkov). Prib. Tekh. Eksp., No. 2, 82-4 (Mar.-Apr. 1967). (In Russian).

Preparation of plastic scintillators of polymethyl methacrylate with naphthalene and methyl methacrylate–styrene copolymers with addition of naphthalene in the presence of luminescent substances is described. It is shown that plastic scintillators with 40% styrene 45% methyl methacrylate, 15% naphthalene, and 0.4 to 0.45% POPOP are as efficient as plastic scintillators of the polystyrene with 2% PPP and 0.1% POPOP. Moreover, they exhibit higher physical and mechanical indices and have a longer life in storage than plastic scintillators with a polystyrene. (tr-auth)

38983 EFFECTS OF HIGH ENERGY IRRADIATION ON THE ELECTRIC PROPERTIES OF EPOXY RESINS. Beine, Horst (Research Station for High Energy Physics, Berlin). Wiss. Z. Elektrotech., 7: 233-45(1966). (In German).

Specimens of cold-setting and thermosetting epoxy resins were irradiated by a 1.5-MeV electron beam with a 10^6 to 10^{10} RAD dose at a 10^5 RAD/sec dose rate. Distintegration of the specimens took place only at high temperatures during irradiation. Both resins showed brown coloring, which increased with dosage. Conductance, surface resistance, track resistance, flashover potential, specific inductive capacity, and phase-angle difference were measured after irradiation. Within 20 hr after irradiation a substantial recovery from radiation effects was observed. The epoxy resins proved to be able to sustain the reported radiation load. (JPRS)

38984 CATALYTIC CARBON MONOXIDE OXIDATION ON X-IRRADIATED ALUMINA. Coekelbergs, R.; Collins, R.; Crucq, A.; Decot, J.; Degols, L.; Timmerman, L. (Ecole Royale Militaire, Brussels). J. Catal., 7: 85-95(Jan. 1967).

The influence of ionizing irradiation of the catalytic properties of alumina was studied in a flow system for oxidation of CO over the temperature range from 25 to 400°C. The catalyst was submitted to irradiation with x rays (55 KV) at a dose rate of 2×10^{19} eV g^{-1} hr^{-1}. Comparison of the results obtained under similar conditions with and without irradiation, indicated that, at a temperature below 300°C, the catalytic activity of irradiated alumina is much higher. This fact may be related to the marked lowering of activation energy with irradiated alumina (18 kcal for the unirradiated catalyst, about 0 kcal in the temperature range from 80 to 300°C, and about 4 kcal at lower temperature for the irradiated alumina). Nevertheless, the reaction order under irradiation remained the same as for unirradiated catalyst; it approached unity with respect to CO pressure, and was between one-fifth and one-half with respect to O_2 pressure. These results as well as previous ones related to the adsorption of CO, O_2, and CO_2 on alumina submitted to irradiation indicated that the rate-determining step for the catalytic oxidation of CO on Al_2O_3 is the chemisorption of O_2. This step is accelerated to a considerable extent by irradiation of alumina. (BBB)

38985 RADICAL TRANSFER REACTIONS AND CHEMICAL PROTECTION IN THE DRY STATE. ELECTRON SPIN RESONANCE STUDIES ON IRRADIATED MIXTURES OF RIBONUCLEASE AND GLYCYL-GLYCINE. Copeland, E. S.; Sanner, T.; Pihl, A. (Norsk Hydro's Inst. for Cancer Research, Montebello, Norway). Eur. J. Biochem., 1: 312-16(May 16, 1967).

Molecular mixtures containing different proportions of ribonuclease and glycylglycine were irradiated with x rays at 77°K and the ESR spectra were observed at this temperature and after heat treatment for 10 min at 60°. In mixtures freeze-dried from pH 8 the number of unpaired spins observed at 77°K corresponded to the weighted average of the yields for the components. In contrast, in mixtures freeze-dried from solutions at pH 4.4 the number of unpaired spins was much higher than expected. The qualitative spectra indicated that these excess radicals were located on glycylglycine. The results obtained after heat treatment indicated that in the samples freeze-dried from pH 8 a considerable transfer of spins occurred from RNase to glycylglycine during the heat treatments, whereas in the samples freeze-dried from pH 4.4 little or no additional transfer seemed to occur. The results indicated that the number of excess radicals at 77°K, as well as the extent of interaction in the mixtures, which occurred on heat treatment, depended on the state of the dissociable groups of the constituents. The finding of excess radicals at 77°K was tentatively attributed to the action of H atoms ejected from RNase. These H atoms were assumed to interact with glycylglycine to form stable radicals, while in the absence of glycylglycine they were assumed to disappear primarily in combination reactions. (BBB)

38986 RADIATION-CHEMICAL EFFECTS IN THE WOOD–VINYL MONOMER SYSTEMS. Varga, S.; Kosik, M. (Slovak Technical Univ., Bratislava). Atomtech. Tajek., 10: 391-406 (1967). (In Hungarian).

Radiation is used to facilitate the combination of wood with plastics, initiating in situ polymerization reactions in wood impregnated with monomers. The basic reaction involves homopolymerization. The radioinduced process, which takes

38924 (COO-1695-3) A KINETIC AND REACTION MECHANISM STUDY OF THE FORMATION AND DECOMPOSITION OF THE URANYL ION IN ORGANIC MEDIA. Quarterly Progress Report No. 1. Shohet, J. L. (Wisconsin Univ., Madison). June 15, 1967. Contract AT(11-1)-1695. 6p. Dep. CFSTI.

The quantum yield for photochemical reduction of uranyl nitrate hexahydrate in propionaldehyde with a 435 mμ mercury band was determined at 25°C. The quantum yield for the reduction of the uranyl nitrate was found to be 0.01. A design for a precision solution calorimeter is described. Improvements incorporated into the instrument are a thin-walled Dewar flask; a thermistor sensor in combination with a Mueller Bridge and voltage amplifier; and certain design features that more effectively isolate the reaction chamber from the constant-temperature surroundings. A two-compartment electrolytic cell was designed and operated using ethyl alcohol–uranyl acetate electrolyte and platinum wire helixes as electrodes. When one half of the unit was illuminated with a sun lamp, a potential of about 0.3 volt developed after a short induction period. An investigation of the complexation of 2-amino-2-deoxygluconic acid with uranium(VI) was made. From spectrophotometric measurements it appears that uranium(VI) formed a complex with 2-amino-2-deoxygluconic acid with maximum stability at pH = 12. (D.H.M.)

38925 (IS-T-182) HEMISPHERICAL SPECTRAL EMITTANCE OF SELECTED RARE EARTH OXIDES. McMahon, William Raymond (Ames Lab., Iowa). May 1967. Contract W-7405-eng-82. 59p. Dep. CFSTI.

Thesis.

The hemispherical spectral emittances for the sesquioxides of yttrium, samarium, gadolinium, erbium, thulium, and ytterbium are given for five wavelengths in the visible portion of the spectrum over a temperature range of 1400 to 3000°K. A reflectance technique incorporating a carbon arc image furnace and a standard of reflectance is used in the determinations. The emittance of zirconium dioxide is determined by the same method and used to check the validity of the method. (auth)

38926 (NP-16957) THERMAL RELAXATION PROCESSES IN GASES. VIBRATIONAL RELAXATION IN CO_2–D_2O MIXTURES. Shields, F. Douglas; Burks, James Alton (Mississippi Univ., University). Aug. 15, 1967. Contract Nonr 3078(01). 18p. CFSTI.

Sound absorption and velocity measurements were made in CO_2–D_2O mixtures at 300, 400, and 500°K. Results show that D_2O is from $\frac{1}{2}$ to $\frac{1}{3}$ as efficient as H_2O in de-exciting the bending mode vibration of CO_2 in a molecular collision. The collision efficiency of D_2O for de-exciting CO_2 decreases with temperature at an even greater rate than does that of H_2O. The large difference between D_2O and H_2O invalidates the chemical affinity explanation of effect of H_2O on CO_2. An approximate semi-classical calculation of the transition probability indicates that it is possible to attribute the relaxation to an interchange between the vibration of the CO_2 and the rotation of the H_2O or D_2O. (auth)

38927 (NYO-3608-4) RELATIVE CATION MOBILITIES IN MOLTEN SALT MIXTURES. Preliminary Report No. 1. Tenney, Albert A.; Laity, Richard W. (Rutgers-The State Univ., New Brunswick, N. J. School of Chemistry). 1967. Contract AT(30-1)-3608. 22p. Dep. CFSTI.

The applicability of some models and the importance of such factors as ion size, cation polarizability, and London forces to the relative mobility of cations is being studied. Silver halide–alkali halide mixtures were chosen for the study. Temperature control, electrolysis circuits, measurement of variables, electrode and cell design, analysis of salt mixtures, and materials and procedure are discussed. (M.C.G.)

38928 (ORNL-4126) MECHANISMS OF SORPTION OF MOLECULAR IODINE. Davis, R. J. (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 31p. Dep. CFSTI.

Based on a detailed study of a selected literature, a classification of the mechanisms of sorption of iodine in a reactor containment is suggested. The important parameters for each mechanism are presented, and illustrations of how these surface chemistry parameters can be incorporated with mass transfer equations are given. Specific research programs are recommended. The six mechanisms are: chemisorption on bare metal; monolayer adsorption with dissociation on dry oxides; diffusion-controlled reactions with oxide-coated metal; absorption into water or aqueous solutions; adsorption on a rapidly forming corrosion film; and sorption from a damp atmosphere. (auth)

38929 (ORNL-P-3203) THERMAL CONDUCTIVITIES OF ^{90}Sr HEAT SOURCE MATERIALS. Ketchen, E. E.; McHenry, R. E. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 13p. (CONF-670714-4). Dep. CFSTI.

From 2nd International Symposium on Nucleonics in Aerospace, Columbus, Ohio.

The thermal conductivities of SrO, Sr_2TiO_4, and $SrTiO_3$ (of a composition that simulates these compounds prepared from nuclear fission fuels waste) are reported. The thermal conductivities were measured using a comparator apparatus, which was altered to evaluate several factors necessary to establish a procedure for measurement of the thermal conductivities of radioactive heat source fuels. The errors in the reported values are assessed and a procedure for high-power-density radioactive samples is described. (auth)

38930 (RFP-922) DISSOLUTION OF PLUTONIUM OXIDE. Molen, Garrel F. (Dow Chemical Co., Golden Colo. Rocky Flats Div.). Aug. 29, 1967. Contract AT(29-1)-1106. 20p. Dep. CFSTI.

The dissolution rate of plutonium oxide as a function of its specific surface area and the mean crystallite size is described. The effect of the solid-to-liquid ratio is measured in both a nitric acid–calcium fluoride solvent system and in a hydrochloric acid–stannous chloride solvent system. (auth)

38931 (LA-tr-67-76) ACTIVITY OF UCl_3 IN THE EUTECTIC LiCl–KCl MELT. Knacke, O.; Krahe, J.; Mueller, F. Translated for Los Alamos Scientific Lab., N. Mex., from Z. Phys. Chem. (Frankfurt), 50: 91-104(1966). 21p. Dep. CFSTI. JCL $2.60 fs, $0. 83 mf.

The activity of UCl_3 was determined by emf measurements in the cell $Ag/U/LiCl-KCl-UCl_3/LiCl-KCl-AgCl/Ag$. At uranium contents up to 0.5 mol % UCl_3 at 450 to 650°C the activity of the UCl_3 was approximately equal to its mole fraction with pure liquid UCl_3 as the reference state. The UCl_3 was generated in the melt itself by anodic dissolution of a uranium rod. The activity coefficient, $f^0_{sol.}$ can be calculated as: $RT \ln f^0_{sol.} = 10{,}850 - 10.21T$ and $\lg f^0_{sol.} = 2372/T - 2.23$. (M.C.G.)

38932 TRACER STUDY ON CATALYTIC HYDROGEN EXCHANGE REACTIONS OVER NICKEL CATALYST. Guczi, L.; Tetenyi, P. (Inst. of Isotopes, Budapest). Isotopenpraxis, 3: 184-7(May 1967).

In heterogeneous catalysis it is important to know the reactivity of C–H bonds in hydrocarbon molecules. Experiments were performed to obtain information about the exchange reaction of adsorbed hydrogen with methane and ethylene. In order to reduce the probability of forming products that contain more than one tritium atom, hydrogen labeled with ^3H with low activity was used. (auth)

38933 DICYCLOPENTADIENYLTECHNETIUM HYDRIDE. Fischer, E. O.; Schmidt, M. W. (Technische Hochschule, Munich). Angew. Chem. Int. Ed. Engl., 6: 93(Jan. 1967).

Dicyclopentadienyltechnetium hydride, $Tc(C_5H_5)_2H$, in 14% yield, and not the dimeric dicyclopentadienyltechnetium, $[Tc(C_5H_5)_2]_2$, was obtained from the reaction of technetium tetrachloride with cyclopentadienylsodium in tetrahydrofuran (THF) and in the presence of sodium tetrahydridoborate. Cyclopentadienylsodium, NaC_5H_5 (10.5 g), was added to a suspension of $TcCl_4$ (3.9 g) in THF (60 ml) at –50°C. After warming to 20°C, $NaBH_4$ (1.0 g) was added to the purple reaction mixture, which was then stirred at 50°C for 10 hr. Evaporation of the solvent and sublimation of the residue at 40 to 60°C/10^{-2} mm gave a yellow solid. Resublimation and recrystallization from toluene gave golden-yellow, pure platelets. Dicyclopentadienyltechnetium hydride is very sensitive to air, but thermally stable. The solid, which melts without decomposition at 150°C, is readily soluble in benzene and toluene but less so in hexane. The molecular weight was found osmometrically in benzene to be 225 (calculated 230.2). (BBB)

38934 USES OF INERT RADIOACTIVE GASES IN THE INVESTIGATION OF SOLIDS. Zhabrova, G. M.; Shibanova, M. D. (Moscow Inst. of Physical Chemistry). Usp. Khim., 36: 1406-26(Aug. 1967). (In Russian).

Theoretical data on emanation methods are reviewed and methods for injection and measuring inert radioactive gases are discussed. Emanation as a function of the specific surface of solids was analyzed. The uses of inert radioactive gases for studying phase transitions, crystal structure alterations, and particle mobility and dimensions are reviewed. The emanation method for investigation of thermal disintegration and interactions of solids, and separation of inert radioactive gases during chemical sorption and catalytic processes on the surfaces of solids are discussed. (88 references.) (R.V.J.)

38935 ON THE MECHANISM OF INTERACTION OF URANYL IONS WITH ARSENAZO III. Tserkovnitskaya, I. A.; Bykhovtsova, T. T. (Leningrad State Univ.). Zh. Anal. Khim., 22: 1201-9 (Aug. 1967). (In Russian).

The complex formation between uranium(VI) and arsenazo(III) in acid solutions was studied by a polarographic method. It was

found that uranium(VI) forms 1:1 and 1:2 complexes with arsenazo (III) in acid solutions. The first complex was soluble and the second complex was a fine-crystalline precipitate. The stability constants of the two complexes were determined. It was shown that on complex formation in the uranium(VI)–arsenazo(III) system both of the functional arsono groups are reactive. (auth)

38936 FINE STRUCTURE OF ISOTOPICALLY LABELED AMINO ACIDS DETERMINED BY ION EXCHANGE CHROMATOGRAPHY. Klein, Peter D.; Szczepanik, Patricia A. (Argonne National Lab., Ill.). Anal. Chem., 39: 1276-81(Sept. 1967).

The chromatographic mobilities of 13 tritium-labeled and 23 radiocarbon-labeled amino acids, representing 11 different amino acids, were measured relative to the unlabeled form and to each other on ion exchange columns. Within a given amino acid, each of the isotopic forms had a mobility distinctly different from the others and that could be determined with considerable precision. There was a strong correlation between the increase in retention volume of radiocarbon-labeled amino acids and the position of the isotope, being maximal in the carboxyl position. Tritium substitution in the 3 position also increased the retention volume, while other tritium locations decreased the retention of the amino acid. Secondary interactions between the isotopic forms during chromatography were revealed by the separation factors between ^3H and ^{14}C forms in the presence and absence of added carrier amino acid. (auth)

38937 COMPLEXES OF URANIUM(VI) WITH OXIDES OF DITERTIARY PHOSPHINES. Sandhu, Sarjit Singh; Sandu, Satinder Singh (Punjabi Univ., Patiala, India). Chem. Ind. (London), No. 33, 1405-6(Aug. 19, 1967).

Complexes of bisbiphenylbutyl- and bisbiphenylethylphosphine oxides with uranyl chloride, bromide, nitrate, acetate, etc. were prepared. These complexes precipitate when solutions of the reactants in n-butyl alcohol are mixed. The complexes are almost insoluble in most organic solvents, but slightly soluble in nitrobenzene, in which they behave as nonelectrolytes. The stretching frequencies for P = 0 and U = 0 bonds in these complexes are tabulated. The results are not in agreement with those of others. A notable feature is the lowering of the stretching frequency of the U = 0 bond by 20 and 30 cm^{-1} in uranyl compounds after complexing, this being due to lowering of d π–pπ interaction. (UK)

38938 HYDROGENATION OF ETHYLENE ON METALLIC CATALYSTS. PART 7. QUALITATIVE VERIFICATION OF THE RATE-DIAGRAM THEORY OF HORIUTI BY DEUTERATION OF LIGHT ETHYLENE ON EVAPORATED NICKEL FILM. Miyahara, Koshiro (Hokkaido Univ., Sapporo). J. Res. Inst. Catal., Hokkaido Univ., 14: 144-52(Dec. 1966).

The theory of Horiuti concerning the rate determining step change for the reaction $H_2 \rightarrow H + H$ to $C_2H_5 + H \rightarrow C_2H_6$, at the optimum temperature, with rise of temperature was qualitatively verified by observation of the initial rate of deuteration of light C_2H_5 catalyzed by evaporated Ni films and D_2 distribution in reacted H_2 and C_2H_5. The Ni film was a used one on which the concurrent dissociative absorption of C_2H_5 was practically suppressed at low temperatures. Temperature dependence of the kinetic isotopic effect, i.e., a ratio of hydrogenation rate of light C_2H_5 by protium to that by D_2 was observed on the same Ni film at 0.1 mm Hg total pressure, resulting in qualitative agreement with the conclusions of the rate-diagram theory. Deuteration on carbided Ni film resulted, in distinction to in the case with a used film, in dilution of D_2 gas by equilibrated protium atoms at temperatures below and above the optimum, revealing a large pressure dependence of its heat of activation at temperatures below the optimum and a temperature-independent kinetic isotopic effect in the same temperature range, which was larger than that on used film throughout the range. These results and the previous ones, i.e., the finding of extremely small hydrogenation rates and adsorbed amounts of H_2 as compared with in the case of used film, suggested another mechanism of hydrogenation of C_2H_5 on carbided film than that applicable for the rate-diagram theory on used film. (BBB)

38939 NEUTRON-DIFFRACTION STUDY OF LaF_3. Choi, Chang-sun (Army Materials Research Agency, Watertown, Mass.). New Phys. (Korea), 7: No. 1, 37-9(June 1967).

The structure of lanthanum trifluoride was investigated by neutron diffraction. The observed data suggest that the crystal has hexagonal symmetry with a mirror plane parallel to the crystallographic c-axis. Using a $P6_3$ cm space group, which is proposed by nuclear magnetic resonance investigation, the atom positions are determined by Fourier summation and the least-squares refinement with anisotropic temperature factor. (auth)

38940 REDUCTION OF SAMARIUM AND ERBIUM ON A DROPPING MERCURY ELECTRODE. Kovalenko, P. N.; Azhipa, L. T.; Tsygankov, E. M.; Evstifeev, M. M. (Rostov State Univ., Rostov-on-Don, USSR). Izv. Vyssh. Uchieb. Zaved., Khim. Khim. Tekhnol., 10: 613-16(1967). (In Russian).

The mechanism of samarium and erbium reduction on a dropping mercury electrode was studied using an oscillographic polarograph with triclectrode thermostatic cell. The analysis was done with samarium and erbium chlorides with a 0.1 n solution of lithium chloride as background. The reduction process of samarium was of a step-line character with the first step $Sm^{3+} + e \rightarrow Sm^{2+}$ and the second $Sm^{2+} + 2e \rightarrow Sm^0$. Three electrons participate in the erbium reduction $Er^{3+} + 3e \rightarrow Er^0$. The magnitude of the maximum current of Sm^{3+} and Er^{3+} was determined as a function of the pH of the solutions. The diffusion and transfer coefficients for the elements examined were determined. (R.V.J.)

38941 HYDROGEN BRIDGE ASSOCIATION AND VAPOR ISOTOPE EFFECTS OF VARIOUS DEUTERATED METHYLAMINES. Wolff, H.; Hoepfner, A. (Univ., Heidelberg). Ber. Bunsenges. Phys. Chem., 71: 461-6(July 1967). (In German).

The vapor pressure isotherms of mixtures of CD_3NH_2 and CD_3ND_2 with n-hexane were measured at temperatures between +20 and –55°C, together with the pressure differences of undiluted CH_3NH_2, CH_3ND_2, CD_3NH_2 and CD_3ND_2. From the isotherms dimerization constants, dimerization energies, solvation energies, and vaporization energies of CD_3NH_2 and CD_3ND_2 were calculated. The differences that exist between CD_3ND_2 and CD_3NH_2 are in agreement with results found for the compounds that are not deuterated in the methyl group. Furthermore, from these measurements vapor pressure quotients were calculated for the pure amines and the solutions in n-hexane. Their comparison shows that for pairs of N-deuterated and non-N-deuterated amines there occurs simultaneously an inverse isotope effect on the vapor pressure ($p^D > p^H$) that is only slightly dependent on the amine concentration and the temperature, and a normal isotope effect on the vapor pressure ($p^D < p^H$) that is markedly dependent on the amine concentration and the temperature. The occurrence of the normal effect only at sufficiently low temperatures and sufficiently high concentrations proves its causal relation with association. Its occurrence on deuteration only of one amino-group suggests moreover that it can be explained in terms of the differences between hydrogen-bond and deuterium-bond association. (auth)

38942 FREE ENERGIES OF FORMATION OF THORIUM SULFIDES FROM SOLID-STATE EMF MEASUREMENTS. Aronson, S. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. J. Inorg. Nucl. Chem., 29: 1611-17(July 1967). (BNL–10839).

Thermodynamic information in the thorium–sulphur system was obtained from measurements on solid electrochemical cells at temperatures of 825 to 925°C. The cells employed were of the following types: Th, $ThF_4|CaF_2|ThF_4$, ThS, Th_α; Th, $ThF_4|CaF_2|ThF_4$, Th_2S_3, ThS; Th, $ThF_4|CaF_2|ThF_4$, Th_7S_{12}, Th_2S_3; and Th, $ThF_4|CaF_2|ThF_4$, ThS_2, Th_7S_{12}. Free energies, entropies, and enthalpies of formation of the sulphides were calculated from the data. Lattice parameter measurements were made on thorium monosulphide to investigate the possibility of nonstoichiometry in this phase. The results of these measurements are discussed. (auth) (UK)

38943 DENSITY OF LIQUID NEPTUNIUM HEXAFLUORIDE. Frlec, B. (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 29: 1804-5(July 1967).

The density of liquid neptunium hexafluoride was measured at 56 to 76°C. The methods used are described, and the values determined are tabulated. (P.C.H.)

38944 IMPACT OF LOW-COST NUCLEAR POWER ON THE CHEMICAL INDUSTRY. Butler, W. S. (Dow Chemical Co., Midland, Mich.). Chem. Eng. Progr., Symp. Ser., 63: No. 71, 8-10(1967).

Heavy chemical manufacture frequently requires large quantities of process steam as well as electric power. These total energy requirements by heavy chemical manufacture have often made on-site power generation feasible using fossil fuels. Nuclear energy cost could be more independent of location, and location could thus serve rather than dictate plant economics. Since the fuel cost of nuclear power will approach zero, or even become negative in the case of the fast breeder reactor, the concept of steam being cheaper than electric heat may fall through the cost of distributing steam lines. Freedom from all forms of air pollution will be of interest to the manufacturers of high-purity chemicals. (auth)

38945 ECONOMICS OF A DUAL CYCLE CHEMONUCLEAR NITROGEN FIXATION PROCESS. Beller, Morris; Epel, Lester G.; Steinberg, Meyer (Brookhaven National Lab., Upton, N. Y.). Chem. Eng. Progr., Symp. Ser., 63: No. 71, 31-44(1967).

An economic and design study for the production of fixed N_2 is presented, which utilizes both direct fission fragment energy and indirect thermal energy from a nuclear reactor. The results in-

dicate that the method can prove competitive with conventional N_2 fixation techniques, provided that G values of at least 6.0 can be achieved and that plant capacities are in the order of 3,000 tons/day fixed N_2. (auth)

38946 AN ECONOMIC STUDY OF THE PRODUCTION OF AMMONIA AND OTHER CHEMICALS WITH THE USE OF ELECTRICITY FROM A NUCLEAR DESALINATION REACTOR COMPLEX. Blanco, R. E.; Holmes, J. M.; Salmon, Royes; Ullmann, J. W. (Oak Ridge National Lab., Tenn.). Chem. Eng. Progr., Symp. Ser., 63: No. 71, 18-30(1967). (ORNL-P-2591).

A survey of twenty industries indicated that production of NH_3 and other fertilizers could probably use large blocks of power most efficiently at a large nuclear-desalination site. The production of H_2 and NH_3 fertilizer via electrolysis was compared with that from the conventional steam-methane reforming process. Factors studied included power cost, natural gas cost, production rate, return on investment, type of electrolytic cell, by-product oxygen credit, and transportation cost. Using electrolytic cells that operate at very high current densities, ammonia can be produced for $39/ton with power at 2.5 to 3.0 mills/kWh. Such power costs are obtainable on an incremental basis from commercial light-water reactors. It is possible that foreign customers may find such systems attractive in competition with purchased NH_3, which may cost $40/ton or more delivered. Large advanced reactors producing power at 1.6 mills/kWh appear to be capable of producing NH_3 competitive in the United States (assuming a credit for by-product oxygen) with NH_3 produced by the conventional steam-methane reforming process, using natural gas at 29 to 33¢/million Btu's. The average U.S. industrial natural gas price in 1963 was 34¢/million Btu's. (auth)

38947 IR SPECTRA OF URANYL ION ATTACHED TO ION EXCHANGE RESINS. Ohwada, K. (Japan Atomic Energy Research Inst., Tokyo). J. Inorg. Nucl. Chem., 29: 1802-3(July 1967).

The work described was undertaken to determine accurately the U–O bond lengths from the ir spectra of the uranyl ion attached to some ion exchange resins. From the asymmetric stretching frequency, the force constant (K′) was determined, and the U–O bond length was then calculated using Badger's rule. (auth) (UK)

38948 CHROMATOGRAPHY ON ION EXCHANGE PAPERS. THE BEHAVIOR OF SOME METAL IONS ON CARBOXYLIC EXCHANGERS. Lederer, M. (CNR, Rome). J. Chromatogr., 29: 306-8(July 1967).

The chromatographic behavior of metal ions on two carboxylic ion exchange papers, carboxymethyl-cellulose paper (Whatman CM-50) and the Amberlite Wa-2 paper, was investigated. Buffers with equal molarities of sodium acetate and acetic acid were used as eluents. Uranyl ions precipitated in the buffer. The R_F values obtained with various molarities of eluents are tabulated. F_e(III) and Zr(IV) gave diffuse comets on Whatman CM-50 paper. Beryllium and aluminum gave double spots on the Amberlite WA-2 paper Most other ions gave elongated spots on the Whatman CM-50 paper and very compact sharp spots on the Amberlite WA-2 paper. (D.H.M.)

38949 PERIODIC POSITION OF LANTHANUM AND ACTINIUM. Dash, H. H. (Variety Children's Hospital, Miami, Fla.). J. Inorg. Nucl. Chem., 29: 1811-12(July 1967).

Villar (J. Inorg. Nucl. Chem. 28: 25(1966)) presented a number of multi-termed equations for calculating the atomic number (Z_p) of an element from its position in the periodic chart. His main thesis, which forms a suggested modification of the chart, is the exclusion of La and Ac from the group of elements constituting the first members of the d-transition series, the scandium group. Alternative methods of calculation which do not support this conclusion are discussed. (auth) (UK)

38950 COUNTERCURRENT DISTRIBUTION OF LABELED ANOMERIC METHYL ARABINOSIDES AND METHYL α-D-MANNOSIDE. Marshall, Lawrence M.; Walker, W. Paul; Gunn, Joycelynn A.; Panton, Lucy (Howard Univ. Coll. of Medicine, Washington, D. C.). J. Chromatogr., 29: 103-7(July 1967).

The isotope effect observed during the countercurrent distribution of arabinose-1-^{14}C did not appear with the methyl glycoside of this labeled pentose. This observation along with the difference in the symmetry of plots for methyl α-D-mannoside and D-mannose were considered in the discussion of such isotope effects. (auth)

38951 SYNTHESIS OF THORIUM SULFITE COMPOUNDS. Golovnya, V. A.; Molodkin, A. K.; Tverdokhlebov, V. N. Zh. Neorg. Khim., 12: 2075-85(Aug. 1967). (In Russian).

Physicochemical studies were made of the system $Th(NO_3)_4 - M_2SO_3 - H_2O$ (where M is Na^+, K^+, and NH_4^+) and the synthesis of thorium sulfite compounds. Thorium aquasulfite, and hydroxysulfite complexes with the ratio from 0.5 to 4.0 were studied. The percentage composition of simultaneously present sulfite and sulfate groups in thorium compounds was determined. (R.V.J.)

38952 METHOD OF PREPARING STRONTIUM TITANATE. (to U.S. Atomic Energy Commission). French Patent 1,341,046. Sept. 16, 1963. Priority date Oct. 31, 1961, United States.

A solution containing $^{90}Sr(NO_3)_2$ and $Ti(NO_3)_3$ (mol. ratio 1 : 1.01; pH ≤ 0.5) is boiled to precipitate H_4TiO_4 and cooled to 35°C. H_2O_2 (100% excess) is added and the pH raised to 11. The combined precipitates of H_4TiO_4 and $^{90}SrO_2$ are filtered, dried, and heated to 400 to 800°C, which gives $^{90}SrTiO_3$. This compound is useful as a heat source in a thermo-electric nuclear battery. (NPO)

38953 BORAZINES SUBSTITUTED BY CYCLIC ORGANIC GROUPS AND THEIR METHOD OF PREPARATION. (to Farbenfabriken Bayer A.G.). French Patent 1,431,245. Jan. 31, 1966. Priority date Mar. 14, 1964, Germany.

A method for the preparation of substituted borazines, which may be used for the preparation of neutron-absorbing polymers, is described. (NPO)

38954 SYNTHESIS OF POTENTIAL RADIATION-PROTECTIVE COMPOUNDS: INVESTIGATION OF THE SYNTHESIS OF MERCAPTOMETHYLAMINE HYDROCHLORIDE, THE SYNTHESIS OF ALPHA-AMINO BUNTE SALTS, AND RELATED COMPOUNDS. Abdou-Sabet, Sabet. College Park, Md., Univ. of Maryland, 1966. 116p.

Thesis.

Simple compounds such as mercaptomethylamine hydrochloride, bis(aminomethyl)disulfide dihydrochloride and S-aminomethylthiosulfuric acid, which may be of potential biological activity especially in the field of radioprotective compounds, were synthesized. Bis(phthalimidomethyl)disulfide was prepared from the known N-bromomethylphthalimide with sodium disulfide. Similarly, bis(α-phthalimidoethyl)disulfide was obtained from N-(α-bromoethyl)phthalimide, which was prepared from N-(α-ethoxyethyl phthalimide. Partial alkaline hydrolysis of bis(phthalimidomethyl)disulfide afforded bis(o-carboxybenzoylaminomethyl)disulfide, which on acid hydrolysis gave six products including the two new compounds bis(aminomethyl)disulfide dihydrochloride and phthalimidomethyl aminomethyl disulfide hydrochloride. Also, hydrazinolysis of bis(phthalimidomethyl)-disulfide gave bis(aminomethyl)disulfide dihydrochloride. Hydrogenolysis of bis(aminomethyl)disulfide dihydrochloride undoubtedly gave mercaptomethylamine hydrochloride, which rearranged, however, to give bis(aminomethyl)sulfide dihydrochloride and hydrogen sulfide. The hydrogenolysis of phthalimidomethyl aminomethyl disulfide hydrochloride produced by-product N-thiolmethylphthalimide, expected from the cleavage of the S-S bond, as well as bis(aminomethyl)sulfide dihydrochloride. The structure of bis(aminomethyl)sulfide dihydrochloride was confirmed by independent synthesis from bis(phthalimidomethyl)-sulfide, which was obtained in the reaction of N-bromomethylphthalimide with sodium hydrogen sulfide. Several approaches to the synthesis of S-aminomethylthiosulfuric acid were investigated. In one synthetic sequence, the N-trifluoroacetyl group was used for protection of the nitrogen. Trifluoroacetamide condensed with chloral to give N-(α-hydroxy-β,β,β-trichloroethyl)-trifluoroacetamide, which was converted to the corresponding chloro derivative with PCl_5. N-(α,β,β,β-Tetrachloroethyl)trifluoroacetamide was dehydrohalogenated with triethylamine to give the imine, which added hydrogen sulfide to form N-(α-thiol-β,β,β-trichloroethyl)trifluoroacetamide. However, the mercapto derivative added to the intermediate imine to give mostly bis(trifluoroacetamido-β,β,β-trichloroethyl)sulfide. In an alternate route, S-detritylation of trifluoroacetamido-β,β,β-trichloroethyl triphenylmethyl sulfide (prepared from the N-(α,β,β,β-tetrachloroethyl)-trifluoroacetamide and triphenylmethyl mercaptan) was investigated. S-Detritylation with mercuric acetate in alcohol, however, produced N-(α-ethoxy-β,β,β-trichloroethyl)-trifluoroacetamide; detritylation in acidic media did not occur. 2-Mercaptoethylamine hydrochloride was found to produce 2-aminoethanethiosulfuric acid by treatment with pyridine sulfur trioxide. However, when mercaptomethylamine hydrochloride (prepared in situ) was allowed to react with pyridine sulfur trioxide, only black oils were obtained. N-Bromomethylphthalimide reacted with sodium thiosulfate to give S-phthalimidomethylthiosulfuric acid sodium salt, which on hydrazinolysis gave N-aminophthalimide, a by-product unprecedented in hydrazinolysis and in disagreement with the accepted mechanism. Hydrazinolysis of S-phthalimidomethylthiosulfuric acid pyridinium salt afforded the hydrazinium salt, or unidentified products and hydrogen sulfide. Self-cleavage of the hydrazinium salt did not afford any desired products. Simultaneous introduction of the two electronegative groups (-S_2O_3H and -NH_2) on a single carbon atom was attempted, by allowing aldehydes and ketones to react with $(NH_4)_2S_2O_3$, but the reaction was accompanied by extensive decomposition. The

reaction of benzalaniline with thiosulfuric acid (prepared in situ by the addition of HCl to $Na_2S_2O_3$) gave aniline tetrathionate and benzaldehyde. When freshly prepared thiosulfuric acid (in methanol at −70°) was added to benzalaniline, an inorganic substance, aniline sulfate, benzaldehyde, and brown oils were obtained. (Disser. Abstr.)

38955 OMAGIU ACAD. PROF. RALUCA RIPAN. (Homage to Academy Professor Raluca Ripan). Bucharest, Editura Academiei Republicii Socialiste Romania, 1966. 627p. (In Several Languages).

Eighty-two papers presented at a meeting to honor Acad. Prof. Raluca Ripan on June 29, 1964, are included. Separate abstracts were prepared for 3 papers. (M.C.G.)

For abstracts of individual papers see: 38956, 38969, and 39006.

38956 THE INFLUENCE OF LIGAND FIELDS ON THE ENERGY LEVELS OF LANTHANIDES AND OF URANIUM(IV). Jezowska-Trzebiatowska, B.; Bukietynska, K.; Legendziewicz, J. (Univ. of Warsaw). pp 613-18 of Omagiu Acad. Prof. Raluca Ripan. Bucharest, Editura Academiei Republicii Socialiste Romania, 1966. (In French).

The influence of ligand fields on the energy levels of electronic $5f^2$ ions was studied by means of the absorption spectra of uranium(IV) and praseodymium(III). As a measure of this influence the experimental magnitude of ζ_{5f} was accepted, and the relation of this magnitude to the spin-orbital coupling constant was shown. On the basis of this magnitude, the order of the ligands was obtained according to the increase of the relativistic nephelauxetic effect. (tr-auth)

Radiation and Nuclear Chemistry

Refer also to abstracts 39142, 39662, 39711, and 40564.

38957 (ANL-7327) A CALCULATION ON THE EFFECT OF NONHOMOGENEITY ON THE DETERMINATION OF THE RATE CONSTANT OF A BIMOLECULAR, SECOND-ORDER REACTION. Sauer, Myran C. Jr. (Argonne National Lab., Ill.). May 1967. Contract W-31-109-eng-38. 5p. Dep. CFSTI.

In pulse-radiolysis experiments, where a beam of electrons is absorbed by a sample, thereby producing chemical transients, the concentration of the transients is often not uniform, due to attenuation and scattering of the electron beam as it passes through the sample. A calculation is presented which shows that, for a chemical transient that disappears by a bimolecular, second-order reaction, wide variation in initial concentration throughout the reaction cell has a negligible effect on the slope of a plot of the reciprocal of concentration vs time, which is contrary to intuition. (auth)

38958 (COO-1618-1) GRADIENT ELUTION ANION EXCHANGE CHROMATOGRAPHY IN HOT-ATOM STUDIES. Anselmo, Vincent C. (New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry). Aug. 1, 1967. Contract AT(11-1)-1618. 11p. Dep. CFSTI.

Gradient elution anion exchange chromatography was applied to the separation of various oxidation states of phosphorus oxyanions produced in thermal-neutron-irradiated orthophosphates, orthophosphites, or hypophosphites. Production of a logarithmic gradient is discussed and the results using several different gradients are illustrated. (auth)

38959 (COO-1618-2) IDENTIFICATION OF COMPLEX PHOSPHATES IN NEUTRON IRRADIATED PHOSPHORUS OXY-ANION SALTS. Anselmo, Vincent C.; Sanchez, Ernest (New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry). Aug. 1, 1967. Contract AT(11-1)-1618. 6p. Dep. CFSTI.

An attempt was made to identify the complex phosphates previously identified as being formed in thermal neutron-irradiated orthophosphates, orthophosphites, and hypophosphites. Gradient elution anion exchange chromatography, under different conditions, was the analytical method used. It was concluded that the species are of high molecular weight and contain more than 14 or 15 phosphorus atoms. (auth)

38960 (COO-1618-4) NITROGEN CONTAINING PHOSPHORUS OXY-ANIONS IN NEUTRON IRRADIATED HYPOPHOSPHITES WHEN DISSOLVED IN LIQUID AMMONIA. Anselmo, Vincent C. (New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry); Sanchez, Ernest (Eberline Instrument Corp., Santa Fe, N. Mex. Radiochemistry Lab.). Aug. 1, 1967. Contract AT(11-1)-1618. 8p. Dep. CFSTI.

Ammonium and calcium hypophosphites were irradiated with thermal neutrons, quenched and stored in liquid nitrogen, dissolved in liquid ammonia, and separated by anion exchange. Quantitative isothermal annealing data are presented on ammonium hypophosphite. Calcium hypophosphite was virtually insoluble in liquid ammonia, so quantitative data are lacking. Data indicated that present in the solution are nitrogen-containing phosphorus oxyanions of unknown compositions that are formed by a reactor between a fragment in the solid and the liquid ammonia. (M.C.G.)

38961 (JAERI-4041) PRODUCTION OF ^{35}S AND PREPARATION OF ITS INORGANIC LABELLED COMPOUNDS. A REVIEW OF METHODS. Shikata, Eiji (Japan Atomic Energy Research Inst., Tokyo). July 1965. 7p. (In Japanese). Dep.

Methods of producing carrier-free ^{35}S from neutron-irradiated potassium chloride and methods of preparing inorganic labeled compounds of ^{35}S are reviewed. The quantity of sulfur compound used as labeled compound and the usefulness for further synthesis-process was considered. Sulfite, thiosulfate, sulfide, thiocyanate, and elementary sulfur were the sulfur compounds considered. (auth)

38962 (AD-628301) INVESTIGATION OF THE ROLE OF FREE RADICALS IN THE ACETALDEHYDE POLYMERIZATION PROCESS IN THE SOLID PHASE UNDER γ IRRADIATION. Pshezetskii, V. S.; Tupikov, V. I. Translated from Vysokomol. Soedin., Geterotsepnye Vysokomol. Soedin., 213-19(1963). 14p. (FTD-TT-65-978). CFSTI. JCL $1.60 fs, $0.80 mf.

The EPR method was used to investigate the processes of formation and recombinations of the radicals that form in crystalline acetaldehyde under γ-irradiation. It was established that in the dose range from 0.1 to 10 MRAD, the radical concentration corresponds in order of magnitude to the concentration of polymer chains. Radical recombination takes place abruptly at temperatures coinciding with the "critical" temperatures determined by the thermographic method. It was found that monomolecular rupture takes place at small radiation doses; at larger doses (0.2 MRAD and up), chain rupture takes place in accordance with a bimolecular law. Ultraviolet radiation initiates polymerization of crystalline acetaldehyde. The nature of the radicals that appear corresponds perfectly to that of the radicals formed on exposure to γ radiation; the concentration of the radicals corresponds to that of the molecular chains. The results obtained justify the assumption that polymerization of crystalline acetaldehyde proceeds by the radical mechanism when initiated by either ionizing radiation or ultraviolet light. (auth)

38963 (JPRS-42164) INDUSTRIAL MANUFACTURE OF HEAVY WATER. Zhavoronkov, N. M.; Zakodynskii, K. K. Translated from Kernenergie, 4: 893-904(1961). 28p. (TT-67-32794). CFSTI.

In a review of the industrial manufacture of heavy water, characteristics of the most important separation methods suitable for production of heavy water (electrolysis, chemical isotope separation, and fractional distillation) are discussed. A survey of the plants constructed, under construction, and planned for the production of heavy water is presented. (63 references.) (D.H.M.)

38964 EFFECT OF GAMMA IRRADIATION ON SOLID-STATE CHLORINATION OF POLYETHYLENE. Dzhagatspanyan, R. V.; Korolev, B. M.; Romanskii, I. A.; Zetkin, V. I. Vysokomol. Soedin., Ser. A, 9: 1195-1200(June 1967). (In Russian).

Chlorination of low-pressure polyethylene in the solid state caused by ^{60}Co γ-irradiation was carried out. Kinetic treatment of the reaction was attempted in the amorphous phase of the polymer. (auth)

38965 CHEMICAL TRANSFORMATION OF POLYVINYL ACETATE AT ITS RADIATION-THERMICAL MODIFICATION. Larin, V. A.; Markova, Z. A.; Yakovenko, V. I.; Bakh, N. A. (Inst. of Electrochemistry, Moscow). Vysokomol. Soedin., Ser. A, 9: 1221-7(June 1967). (In Russian).

Radiothermal transformations of polyvinyl acetate were studied using gas-liquid chromatography and ir spectra. When samples were irradiated with 4-MeV electrons, acetic acid, methane, hydrogen, carbon monoxide, and minor amounts of carbon dioxide were identified as the main products. In all stages of pseudo-oxidation in an oxygen atmosphere at 200 to 250°C and pyrolysis in an oxygen-free atmosphere at 400 to 800°C, the processes of deacylation and dehydrogenation to the polyconjugation system were predominant. The hydrogen content was similar to poly-ring hydrocarbons with developed conjugation system. The polyconjugated system developed as a result of rupture of alternating substituents showed better electrical characteristics than the polyethylene system. (auth)

38966 EFFECT OF POLYFUNCTIONAL MONOMERS ON RADIATION CROSSLINKING OF POLYETHYLENE. Egorova, Z. S.; Karpov, V. L.; Leshchenko, S. S.; Mitrofanova, L. V.;

Finkel, E. E. (Scientific-Research Physical-Chemical Inst., Moscow. Scientific-Research Inst. of the Cable Industry, Moscow). Vysokomol. Soedin., Ser. A, 9: 1451-8(July 1967). (In Russian).

The effect of triallyl cyanurate (TAC), diallyl maleate (DAM) and allyl methacrylate (AMA) on polyethylene (PE) crosslinking and polyfunctional monomer (PFM) introduction were studied by means of extraction and IR spectroscopy. All tested PFM was shown to effectively sensitize radiation PE crosslinking in air (except DAM) and in an inert gas atmosphere their action was effective at doses not higher than 50 MRAD. Not only PFM addition to polymer radicals occurred during irradiation but partial polymerization also occurred. The PFM efficiency depended to a considerable extent on the method of their introduction into PE. Thermal treatment caused polymerization of PFM and decreased its efficiency. (auth)

38967 EPR METHOD FOR INVESTIGATION OF SULFUR REACTIONS WITH RUBBER DURING RADIOLYSIS FOLLOWED BY LIGHT ILLUMINATION. Kozlov, V. T.; Tarasova, Z. N.; Klinshpont, E. R.; Milinchuk, V. K.; Dogadkin, B. A. (Scientific-Research Inst. of the Tire Industry, Moscow). Vysokomol. Soedin., Ser. A, 9: 1541-7(July 1967). (In Russian).

The ESR spectra of some mixtures of rubber and sulfur, irradiated at −196°C, showed the presence of radicals with g = 2.003 and g = 2.027. The phenomenon is expressed to a higher extent the lower the T_g of the rubber. When the temperature was increased the concentration of the radicals with g = 2.027 was increased and attained a maximum at T_g. The absence of sulfur widened the radicals decay region to temperatures below T_g. Light illumination caused the radicals decay to be more intense from the red to ultraviolet region and in the presence of sulfur. The results are explained by the reaction of radicals and ions, stabilized by the radicals the latter act as mobile species. (auth)

38968 STUDIES ON AZULENES. I. THE ACTION OF RADIANT RAYS ON AZULENES. THE γ-RAY IRRADIATION ON GUAIAZULENE. Otani, Yasushi; Ogura, Isao; Hirayama, Hiroshi; Kyotani, Masahiro; Takeda, Giichi (Konan Kako Co., Ltd., Osaka). Yakugaku Zasshi, 87: 242-6(1967). (In Japanese).

Isoöctane solutions and crystals of guaiazulene were γ-irradiated with 10^2- to 10^8-R doses from ^{60}Co, and their absorption spectra were measured in the uv region. An aqueous solution of sodium guaiazulene-3-sulfonate was also similarly irradiated and changes in uv spectra were measured. There was no general change in uv absorption but the visible spectrum of the irradiated isoöctane solution showed changes, of arithmetic mean type of about 40, in the mean value of total absorption in the absorption × 10^3 value and about 12 in the fluorescence spectra, with the 10^8-R irradiation dose. Thus, in general, the absorption values changed in an arithmetic or geometric series up to a certain limit with the irradiation dose. The ir and nmr spectra of guaiazulene crystals irradiated with γ rays showed practically no changes from those of nonirradiated guaiazulene. (BBB)

38969 POLAROGRAPHIC INVESTIGATION OF γ-IRRADIATED AQUEOUS SOLUTIONS OF INSULIN. Brdicka, R.; Fojtik, A.; Spurny, Z. (Inst. of Physical Chemistry, Prague. Inst. of Nuclear Research, Prague). pp 163-6 of Omagiu Acad. Prof. Raluca Ripan. Bucharest, Editura Academiei Republicii Socialiste Romania, 1966.

The effects of γ-irradiation on aqueous solutions of insulin were studied by measurement of the height of the polarographic double-wave due to the catalytic effect of disulfide groups contained in the molecule of insulin. The analysis of experimental data showed that the course of polarographic inactivation of these groups follows a first order reaction after a certain induction period elapsed. (auth)

38970 SOME EFFECTS OF γ-IRRADIATION IN POLYTETRAFLUOROETHYLENE FILLED WITH CARBON BLACK. Fock, J. (Polytechnic Inst. of Brooklyn). J. Polym. Sci., Part B, 5: 635-40(Aug. 1967).

Homogeneous mixtures of polytetrafluoroethylene (Teflon) and carbon black were irradiated under vacuum at 10^{-5} Torr in a ^{60}Co γ source at a dose rate of 2 × 10^5 R/hr. Differential thermal analyses and mechanical tests were carried out. While 10 to 25% pure carbon black improved the tensile strength up to 25 MRAD, as little as 5% carbon black containing 2% volatiles caused pronounced deterioration after irradiation. Tensile strength decreased slightly in annealed material filled with pure carbon black, whereas it increased in the quenched material. Mechanisms are suggested for the observed increase in crystallinity. (P.C.S.)

38971 EFFECT OF TEMPERATURE ON THE YIELDS OF THE PRECURSORS OF HYDROGEN IN THE RADIOLYSIS OF ETHANOL. Basson, R. A. (Atomic Energy Board, Pretoria). J. Chem. Soc. A, No. 7, 1179-82(1967).

The yields of solvated electrons and hydrogen atoms, the precursors of hydrogen in the radiolysis of ethanol, were determined as a function of temperature. $G(H_2)$ and $G(H_2)_m$ were independent of temperature, but $G(e^-)$ increased and G(H) decreased with decreasing temperature. This result was interpreted as the increasing probability of sub-excitation escape from the field of the parent ion with increasing dielectric constant. A plot of $G(e^-)$ against ϵ was in good agreement with previous work on other alcohols, and in qualitative agreement with theoretical predictions. (auth) (UK)

38972 THE RADIATION CHEMISTRY OF n-PROPANOL. PART I. FORMATION OF THE MAJOR PRODUCTS. Basson, R. A.; van der Linde, H. J. (Atomic Energy Board, Pretoria). J. Chem. Soc., A, No. 7, 1182-6(1967).

The major products of the radiolysis of pure liquid propanol are hydrogen, propionaldehyde, and hexane-3,4 diol. The initial yields are $G(H_2)$ = 4.4, G(EtCHO) = 2.9, and $G(EtCHOH)_2$ = 1.5, but the hydrogen and aldehyde yields decrease with increasing dose. This effect has been shown to be due to scavenging of a precursor of hydrogen by the aldehyde. Studies with solutes have shown that hydrogen has as its precursor solvated electrons and hydrogen atoms which may be scavenged, and also that part of the yield of this product is due to molecular processes. Yields and rate constants of the intermediates were determined. (auth) (UK)

38973 CORRELATION OF ESR SPECTRA OF IRRADIATED POLY(GLYCOL METHACRYLATE) AND POLY(METHYL METHACRYLATE). Szocs, F. (Inst. of Polymers, Slovak Academy of Science, Bratislava); Ulbert, K. J. Polym. Sci., Part B, 5: 671-6(Aug. 1967).

Polymers of ethylene glycol bismethacrylate were x-irradiated under vacuum with a dose of 10^6 rads and ESR spectra were studied. Results are in agreement with previous ESR literature on polymethylmethacrylate. Due to the retarding influence of crosslinking on the velocity of decay, another radical appeared to be coincident with the fifth line of the nine-line spectrum. Mechanisms are suggested for the changes of the ratio of the intensities of the spectral lines during the decay at constant temperature. (P.C.S.)

38974 BRANCHING IN POLY(METHYL METHACRYLATE) OBTAINED BY γ-RAY IRRADIATION. Blumstein, Alexandre (Lowell Technological Inst., Mass.). J. Polym. Sci., Part B, 5: 687−90(Aug. 1967).

Radiation effects on methyl methacrylate monomers were studied using a high dose of ^{60}Co γ radiation. The resulting high-intensity polymers were hard, yellow, did not swell appreciably, and dissolved with great difficulty in toluene. Branching during the polymerization appeared to occur during the early period of irradiation. This suggests that the distinction between crosslinking and degrading polymers may not be as drastic as asserted by many authors. (P.C.S.)

38975 ASSIGNMENT OF THE METHYLENE PROTON SIGNALS AND ESTIMATION OF THE MESO-TO RACEMIC METHYLENE RATIOS IN POLYACRYLONITRILES. Yoshino, Tsuneo; Kenjo, Hideki; Kuno, Kiyoshi (Toyo Rayon Co., Kanagawa, Japan). J. Polym. Sci., Part B, 5: 703-9(Aug. 1967).

NMR spectra of x-polymerized polyacrylonitriles were compared with those of polymers prepared by a radical process. Elimination of geminal proton coupling proved effective for authentic assignment of the methylene signals and reliable estimation of the meso-to-racemic methylene ratio of a polymer with diad signals close to each other. The ratio in polyacrylonitrile was disposed of using this method. (P.C.S.)

38976 INITIAL PRODUCTS FROM RADIOLYSIS OF WATER AND THEIR REACTIONS WITH DISSOLVED SUBSTANCES. Pikaev, A. K.; Ershov, B. G. (Saratov State Univ., USSR). Usp. Khim., 36: 1427-59(Aug. 1967). (In Russian).

A brief review is given on the free radical theory of the radiolysis of water. Hydrated electrons, hydrogen atoms, OH radicals, HO_2 radicals, oxygen atoms, water excitation, molecular products of H_2 and H_2O_2, and the maximum yields of water disintegration are discussed. (472 references.) (R.V.J.)

38977 RADIOCHEMISTRY OF WATER, AQUEOUS SOLUTIONS, AND SIMPLE ORGANIC COMPOUNDS. Minder, Walter (Eidgenoessische Gesundheitsamt, Bern). pp 39-182 of Handbuch der Medizinischen Radiologie, Vol. 2, Part 1. Berlin, Springer Verlag, 1966. (In German).

The overall field of radiation chemistry including analytical methods and irradiation techniques is surveyed. Special attention is given to some aqueous inorganic systems, including radiochemistry of H_2O, primary reactions of H_2O, and radiation oxidation of $FeSO_4$, as well as to some radiochemistry of simple organic compounds. (438 references). (TSS)

38978 RADIOINDUCED REACTIONS IN POLYOXYMETHYLENE. Fischer, H.; Langbein, W. (Deutsches Kunststoff-In-

stitut, Darmstadt, Ger.). Kolloid-Zh., 216-17: 329-36(Mar.-Apr. 1967). (In German).

Radioinduced reactions in high polymers were investigated by electron irradiation, at a dose rate of 15 MRAD/min and doses of up to 400 MRAD, of polyoxymethylene diacetate $CH_3COO(CH_2O)_n COCH_3$. Delrin 500, molecular weight 31,000, was irradiated in vacuo at 14°C by 1-MeV electrons. The radioinduced reactions were studied by measurements of solubility, by ir spectroscopy, nmr spectroscopy, and gas chromatography. In agreement with findings for polyethylene and polyethylene oxide, the direct cross linking reaction occurs, and, additionally, two degradation reactions. These degradation reactions showed the influence of the oxygen atoms in the molecular chain, which was more pronounced in polyoxymethylene than in polyethylene oxide, corresponding to the higher content of oxygen in polyoxymethylene. (BBB)

38979 SOFT WOOD GETS TOUGH. Mod. Plast., 44: 96-7; 184(Mar. 1967).

Development of a radiopolymerization process for hardening wood is discussed. The process is based on impregnating ordinary, low-density wood with a plastic monomer and polymerizing it in the wood by radiation to produce a new material with all of the properties of a high-density hardwood. The product is considered superior to untreated wood in all respects except 2: it is heavier, since 1 lb of monomer goes into every pound of wood treated, and it will not take nails. Wood parts to be treated are first impregnated with monomer and then exposed to a ^{60}Co source to effect polymerization. The wood-plastic composite (WPC) develops a hardness reading 4½ times that of untreated wood. It has a permanent gloss that is self-renewing. It has improved weatherability, durability, and dimensional stability. Properties reported to be improved by both methods include hardness; compressive, bending, and shear strengths; toughness; water and moisture absorption resistance; decay, fungus, and chemical resistance; machineability; and, with the addition of suitable additives, fire retardancy. (BBB)

38980 THE RADIATION CHEMISTRY DATA CENTER. Ross, Alberta B. (Univ. of Notre Dame, Ind.). J. Chem. Doc., 7: 34-6(Feb. 1967).

A description is given of the scope, function, and facilities of the Radiation Chemistry Data Center, a specialized data center under the chemical kinetics program of the National Standard Reference Data System, and supported jointly by the Division of Technical Information of the Atomic Energy Commission and by the National Bureau of Standards. Radiation chemistry data include rates of elementary processes and yields of products and intermediates formed by the action of ionizing radiation on definable chemical systems. The Center was established to bring together all information of radiation chemistry and provide a means of making selected and evaluated data readily available to scientists throughout the world. All possible sources of data from radiation chemistry are being collected. The information is indexed by keywords, and the numerical values reported for measurements of chemical and physical properties of the irradiated systems are recorded. The data file is not a manual operation but future plans include the transfer of data to machine-searchable form. Sources of recording errors are discussed. (BBB)

38981 STUDIES ON X AGENT. LII. DEMONSTRATION OF THE ACTIVATION OF WATER BY THE APPARENT CHANGE OF ITS TRANSPARENCY. Moriyama, Hideo (Shonan Hygiene Inst., Kamakura, Japan). Yokohama Med. Bull., 18: 5-14(Feb. 1967).

To determine the effect of this biological agent on water the transmittance change of an absorption cell, used with the Leitz photometer, filled with water was examined. It was confirmed that, in addition to an effect on the glass surface of the cell, the water contained in the cell was altered, as shown by a transmittance change. Radiation passing through the activated glass was thought to be given a special energy, with which water was activated. Radiation activated in such a manner affected the photoelectric cell in the photometer, resulting in a temporary apparent change of transmittance. The photoelectric cell reacted to the activated radiation more strongly than to the normal light. The activated state of the water seemed more lasting than that of the glass surface. However, the activated state was lost after exposure to strong light. The frosted glass surface was activated more frequently than the water, insofar as the activation was demonstrable by the transmittance change. (BBB)

38982 MIXED-BASE PLASTIC SCINTILLATORS. Bezuglyi, V. D.; Mukhina, S. A. (All-Union Scientific Research Inst. of Monocrystals, Kharkov). Prib. Tekh. Eksp., No. 2, 82-4 (Mar.-Apr. 1967). (In Russian).

Preparation of plastic scintillators of polymethyl methacrylate with naphthalene and methyl methacrylate–styrene copolymers with addition of naphthalene in the presence of luminescent substances is described. It is shown that plastic scintillators with 40% styrene 45% methyl methacrylate, 15% naphthalene, and 0.4 to 0.45% POPOP are as efficient as plastic scintillators of the polystyrene with 2% PPP and 0.1% POPOP. Moreover, they exhibit higher physical and mechanical indices and have a longer life in storage than plastic scintillators with a polystyrene. (tr-auth)

38983 EFFECTS OF HIGH ENERGY IRRADIATION ON THE ELECTRIC PROPERTIES OF EPOXY RESINS. Beine, Horst (Research Station for High Energy Physics, Berlin). Wiss. Z. Elektrotech., 7: 233-45(1966). (In German).

Specimens of cold-setting and thermosetting epoxy resins were irradiated by a 1.5-MeV electron beam with a 10^6 to 10^{10} RAD dose at a 10^5 RAD/sec dose rate. Disintegration of the specimens took place only at high temperatures during irradiation. Both resins showed brown coloring, which increased with dosage. Conductance, surface resistance, track resistance, flashover potential, specific inductive capacity, and phase-angle difference were measured after irradiation. Within 20 hr after irradiation a substantial recovery from radiation effects was observed. The epoxy resins proved to be able to sustain the reported radiation load. (JPRS)

38984 CATALYTIC CARBON MONOXIDE OXIDATION ON X-IRRADIATED ALUMINA. Coekelbergs, R.; Collins, R.; Crucq, A.; Decot, J.; Degols, L.; Timmerman, L. (Ecole Royale Militaire, Brussels). J. Catal., 7: 85-95(Jan. 1967).

The influence of ionizing irradiation of the catalytic properties of alumina was studied in a flow system for oxidation of CO over the temperature range from 25 to 400°C. The catalyst was submitted to irradiation with x rays (55 KV) at a dose rate of 2×10^{19} eV g^{-1} hr^{-1}. Comparison of the results obtained under similar conditions with and without irradiation, indicated that, at a temperature below 300°C, the catalytic activity of irradiated alumina is much higher. This fact may be related to the marked lowering of activation energy with irradiated alumina (18 kcal for the unirradiated catalyst, about 0 kcal in the temperature range from 80 to 300°C, and about 4 kcal at lower temperature for the irradiated alumina). Nevertheless, the reaction order under irradiation remained the same as for unirradiated catalyst; it approached unity with respect to CO pressure, and was between one-fifth and one-half with respect to O_2 pressure. These results as well as previous ones related to the adsorption of CO, O_2, and CO_2 on alumina submitted to irradiation indicated that the rate-determining step for the catalytic oxidation of CO on Al_2O_3 is the chemisorption of O_2. This step is accelerated to a considerable extent by irradiation of alumina. (BBB)

38985 RADICAL TRANSFER REACTIONS AND CHEMICAL PROTECTION IN THE DRY STATE. ELECTRON SPIN RESONANCE STUDIES ON IRRADIATED MIXTURES OF RIBONUCLEASE AND GLYCYL-GLYCINE. Copeland, E. S.; Sanner, T.; Pihl, A. (Norsk Hydro's Inst. for Cancer Research, Montebello, Norway). Eur. J. Biochem., 1: 312-16(May 16, 1967).

Molecular mixtures containing different proportions of ribonuclease and glycylglycine were irradiated with x rays at 77°K and the ESR spectra were observed at this temperature and after heat treatment for 10 min at 60°. In mixtures freeze-dried from pH 8 the number of unpaired spins observed at 77°K corresponded to the weighted average of the yields for the components. In contrast, in mixtures freeze-dried from solutions at pH 4.4 the number of unpaired spins was much higher than expected. The qualitative spectra indicated that these excess radicals were located on glycylglycine. The results obtained after heat treatment indicated that in the samples freeze-dried from pH 8 a considerable transfer of spins occurred from RNase to glycylglycine during the heat treatments, whereas in the samples freeze-dried from pH 4.4 little or no additional transfer seemed to occur. The results indicated that the number of excess radicals at 77°K, as well as the extent of interaction in the mixtures, which occurred on heat treatment, depended on the state of the dissociable groups of the constituents. The finding of excess radicals at 77°K was tentatively attributed to the action of H atoms ejected from RNase. These H atoms were assumed to interact with glycylglycine to form stable radicals, while in the absence of glycylglycine they were assumed to disappear primarily in combination reactions. (BBB)

38986 RADIATION-CHEMICAL EFFECTS IN THE WOOD–VINYL MONOMER SYSTEMS. Varga, S.; Kosik, M. (Slovak Technical Univ., Bratislava). Atomtech. Tajek., 10: 391-406 (1967). (In Hungarian).

Radiation is used to facilitate the combination of wood with plastics, initiating in situ polymerization reactions in wood impregnated with monomers. The basic reaction involves homopolymerization. The radioinduced process, which takes

place with formation of free radicals, has the advantage that the final product is free from contamination by foreign chemicals used for initiating the reaction. The length of the chains formed depends on the dose rate: high dose rates create shorter molecules. The monomer systems used include styrene, acrylic compounds, and vinyl monomers. Very high radiation, exceeding a total dose of 10^8 R, affects the wood; the lignin component is more resistant than the cellulose. Radiolysis of wood is related to the degradation of saccharides and the dissolution of the lignin–saccharide bonds. The monomer-impregnated specimens are usually irradiated with a 10^3-Ci ^{60}Co source; for very thin wood specimens, Van de Graaff accelerators may be used. Completion of the polymerization reaction is usually difficult to detect. (Review article, 116 references). (TTT)

38987 GAMMA AND NEUTRON RADIOLYSIS OF THE SYSTEM TRICHLOROETHYLENE–OXYGEN–WATER. Sasse, Ronald A. (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Health Phys., 13: 1015-24(Sept. 1967).

The gamma and neutron radiolysis of aqueous trichloroethylene (TCE) was investigated. The yield of H^+ was determined by dynamic measurement of electrical conductivity. Yields of other products (Cl^-, H_2O_2, H_2, CO_2, CO, and HCOCOOH) were quantitatively determined by various analytical techniques. $G(Cl^-)$ was generally equal to $G(H^+)$. $G(H^+)$ increased with increasing oxygen concentration, increasing TCE concentration, and decreasing Linear Energy Transfer (LET). The maximum value observed was 126. $G(CO_2)$, G(CO), and G(HCOCOOH) were smaller by factors of 5 to 10. $G(H_2)$ and $G(H_2O_2)$ were indistinguishable from values observed in pure water. The oxygen-rich TCE system yields were found to be very dose-rate dependent, whereas the air-free system was not. A mechanism is proposed for the air-free TCE system based on limiting G values obtained by adding scavengers. (auth) (UK)

38988 THE CHEMICAL EFFECTS OF NEUTRON CAPTURE IN cis- AND trans-DICHLOROBIS(ETHYLENEDIAMINE)-CHROMIUM(III) NITRATE. Lin, Robert I-san; Lefohn, Allen S.; Garner, Clifford S. (Univ. of California, Los Angeles). J. Inorg. Nucl. Chem., 29: 1553-7(July 1967).

The chemical effects of the $^{50}Cr(n,\gamma)^{51}Cr$ reaction in polycrystalline cis- and trans-$[Cr(en)_2\text{-}Cl_2]NO_3$ were studied, together with the isothermal annealing of the ^{51}Cr(27.8 days) recoil species. After irradiation of a given isomer, 1 to 2 percent of the total ^{51}Cr radioactivity was retained in the parent isomer, increasing to 7 to 13 percent on annealing for 5 days at 110°C; <1 percent of the ^{51}Cr radioactivity was found in the other isomeric form, with little or no increase on annealing. (auth) (UK)

38989 PULSE RADIOLYTIC INVESTIGATION OF THE OXIDATION OF PHENYLHYDROXYLAMINE IN AQUEOUS SOLUTIONS. Wigger, A.; Henglein, A.; Asmus, K.-D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Ber. Bunsenges. Phys. Chem., 71: 513-16(July 1967). (In German).

The OH radical was added to phenylhydroxylamine with $k = 1.5 \times 10^{10}$ M^{-1} sec^{-1}. The decay of the addition product that splits off water was catalyzed by H^+ and OH^- ions ($k = 1.8 \times 10^5$ sec^{-1} at pH = 7). The C_6H_5NOH radical was produced in this decay. The disproportionation of two C_6H_5NOH particles led to phenylhydroxylamine and nitrosobenzene. The rate constant of disproportionation depended on the pH of solution. It reached its highest value of 5×10^7 M^{-1} sec^{-1} at about pH = 11.7 (p_K of the equilibrium $C_6H_5NOH \rightleftharpoons C_6H_5NO^- + H^+$). The optical absorption spectra of all intermediates of the oxidation were measured. Some preliminary experiments on the reduction of phenylhydroxylamine were carried out. The hydrated electron reacts with $k = 1.8 \times 10^9$ M^{-1} sec^{-1}. (auth)

38990 RADIATION SENSITIVITY OF DETERGENT LAMELLA. Bergeder, H. D.; Koerner, W.; Meissen, H. (Univ., Bonn). Naturwissenschaften, 54: 319(1967). (In German).

A study was made to determine whether radiation effects are present for the purest possible detergents in aqueous solutions. Studies were made on three detergents using x radiation and $CaCl_2$ additive. It was found that radiation sensitivity is not a general characteristic of detergent lamella. (M.C.G.)

38991 SIXTH ANNUAL CONTRACTORS' MEETING ON PROCESS RADIATION DEVELOPMENT. Greene, R. E. Isotop. Radiat. Technol., 4: 259-65(Spring 1967).

Papers presented at the USAEC's Division of Isotopes Development Sixth Annual Contractors' Meeting, held at Germantown, Md., September 26 and 27, 1966, on process radiation development are briefly summarized. The papers covered work on polymerization and copolymerization, radioinduced synthesis, chemical reactors for radiation processing, source development, irradiation studies, and radiation processing of materials. (auth)

38992 AN ELECTRON SPIN RESONANCE STUDY OF ^{60}Co-IRRADIATED MONOCRYSTALLINE PHENANTHRENE. Hankla, Robert H. Nashville, Vanderbilt Univ., 1966. 102p. Thesis.

Single crystals of phenanthrene ($C_{14}H_{10}$) were grown by the Bridgman technique. The crystals were irridiated using ^{60}Co and subsequently oriented by x-ray-precession photography. Irradiation did not alter the crystal constants. For purposes of the ESR investigation, the orthogonal axes a, b, and c were chosen as rotation axes. All rotations were performed in a right-handed sense from 0 to 180° in 10 to 15° steps. The ESR spectra were recorded at X-band at 30 mw power level with 100 kc modulation frequency. The investigation was conducted to determine, by studying the magnetic dipole-dipole interaction, the nature and location of the unpaired electron resulting from the irradiation treatment. When analyzed, the data are consistent with coupling constants ±20.7, ±14.2, and ±4.5 G parallel to the long axis, normal to the plane, and parallel to the short axis, respectively, of the $C_{14}H_{10}$ molecule. These magnitudes are each 56% of theoretical estimates based on a C-H fragment, thereby indicating an unpaired electron spin density of ±0.56 on some C atom to which a proton is bonded. These values for the principal coupling constants lead to strong forbidden transitions along the b-axis, while the allowed transitions dominate elsewhere. The changing of the relative transition intensities accounts for the obscuring effects just off the b-axis. The collapse of the spectrum along the b-axis is therefore not real, but represents a different set of transitions. There is, however, no C–H bond system within the crystal that has the orientation corresponding to the observed principal directions; the 30° disparity is well outside the uncertainty of the angular data. It was concluded that either a molecular distortion has occurred as a result of irradiation or that a hitherto unreported interaction mechanism, peculiar to a highly conjugated system, is operable. This conclusion was drawn after considered rejection of other known electron interactions. (Disser. Abstr.)

38993 METHOD FOR INHIBITING RADIATION DAMAGE TO TRIBUTYL PHOSPHATE SOLVENT. (to Nihon Genshiryoku Kenkyu Sho). French Patent 1,370,357. July 15, 1964. Priority date Dec. 12, 1962, Japan.

Radiation damage to TBP solvents is inhibited by addition of hydroquinone, triphenylmethane, tetrachloro-p-benzoquinone, p-phenylenediamine, tetramethylthiuram disulfide, or other compounds capable of expelling radicals. (NPO)

Radiochemistry

38994 (NP–16796) COMPARAISON INTERNATIONALE D'UNE SOLUTION DE $^{90}Sr + ^{90}Y$ PAR LA METHODE $4\pi\beta$(CP) DEUXIEME PARTIE: ANALYSE DES RESULTATS. (International Comparison of a Solution of $^{90}Sr + ^{90}Y$ by the $4\pi\beta$(CP) Method. Part II. Analysis of Results). Rytz, A. (Bureau International des Poids et Mesures, Sevres (France)). Feb. 1964. 31p. (In French). Dep.

Twenty-four laboratories participated in a comparative measurement of the activity of $^{90}Sr + ^{90}Y$ solutions using the $4\pi\beta$ (CP) method. Two solutions, a weak one and a strong one, were supplied. The results are graphed and show a wide dispersion. It was estimated that the error of dilution, however, did not exceed ±0.5%. One of the primary sources of the dispersion was the absorption corrections applied. (J.S.R.)

38995 MICROCHEMICAL TECHNIQUES AS APPLIED TO RADIOCHEMISTRY. Cefola, Michael (Fordham Univ., Bronx, N. Y.). Mikrochim. Acta, No. 4, 732-41(July 1967).

Techniques for investigating the chemistry of radioactive elements using microgram quantities of material are described. These include methods of transfer and carrying out reactions, determination of solubility, valence state and half-life value, and vapor pressure measurements. (auth)

38996 EFFECT OF TEMPERATURE, pH AND AGING ON SOME PROPERTIES OF RADIOACTIVE GOLD COLLOID. El-Guebeily, M. A.; Abdel-Rassoul, A. A.; Fouad, H. (Atomic Energy Establishment, Inchass, UAR). J. Chem. UAR, 9: 129-38(1966).

The effect of temperature, pH, and aging on the stability and particle size of colloidal ^{198}Au preparations was studied. The % change of free ionic ^{198}Au with temperature was also investigated. The results obtained from the different treatments, as examined by spectrophotometry, centrifugation, or by paper chromatography, were generally in agreement. They indicated that the sol is stable below 60°C, does not change with age, and contains a minimum of free ionic ^{198}Au. Increase of temperature above 60°C as well as

increase of acidity or alkalinity led to obvious changes in particle size, which rendered the sol unfavorable for medical use. The effect of lowering the pH was attributed to the equilibrium established between colloidal particles and adsorbed $(AuCl_2)^-$ ions on one hand and the H^+ and $(AuCl_2)^-$ ions in solution on the other hand. Among the various factors affecting such equilibrium, the increase in acidity would require an increase in the number of $(AuCl_2)^-$ ions adsorbed on the colloidal particles, which could be partially satisfied by the division of some colloidal particles into smaller ones. Homogeneous particle-size distribution was only attainable at a pH range from 5 to 7. Gold-198 colloid solutions in the pH range from 5 to 7 were of high stability, resisting aging effects at room temperature, at least for 3 months. This high stability of the chlorosol was mainly attributed to the protecting action of gelatin. (BBB)

Separation Processes

Refer also to abstracts 38883, 39142, 39563, 40641, 40694, and 40732.

38997 (EUR-3299.f) LA RECUPERATION DES PRODUITS DE FISSION. Rapport Final Octobre 1962-Avril 1966. (Recovery of Fission Products. Final Report, October 1962-April 1966). (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Apr. 1967. 62p. (In French). Dep.

Results obtained from more than three years of study on the recovery of fission products from waste solutions available in France are reviewed. Techniques used for the analysis of fission-products solution are outlined. The separation of ^{137}Cs and ^{90}Sr was studied. The ion-exchange technique using mineral exchangers was the most satisfactory. With mineral ion exchangers the mother solution could be processed without modification. Techniques for the separation of the rare earths were also studied. A pilot plant for the separation of ^{137}Cs was designed and is being constructed. (J.S.R.)

38998 (FTB-4) CONVERSION OF URANIUM HEXAFLUORIDE TO URANIUM DIOXIDE. Nystrom, Anders (Aktiebolaget Atomenergi, Studsvik (Sweden)). July 1967. 30p. Dep. SWED.

A literature survey of 78 references on the subject was compiled from Nuclear Science Abstracts covering the period from 1963 through June 1967. The references were retrieved under the subject heading Uranium(VI) Fluorides. Such aspects as analytical methods, instrumentation, handling procedures, purification, fluorine recovery, properties, and safety are considered. The survey is supplied with abstracts and subject and author indexes. (auth)

38999 (NLCO-1001, pp 1.1-17) COMPUTER PROGRAMS FOR REFINERY CAMPAIGNS. Kispert, R. C.; Leist, N. R.; Stoneking, D. J.; Williamson, J. A. (National Lead Co. of Ohio, Cincinnati).

Two FORTRAN computer programs were developed for determining Refinery feed batch compositions using the Honeywell-200 digital computer. Calculations for both enriched and normal phosphate ash campaigns are performed by the PANLO Program. The LANLO Program is used for the computation of residue feed batches that are processed using the low-acid flowsheet. Related process rates are calculated, and the drum dumping schedule is specified in each computation. (auth)

39000 (NLCO-1001, pp 3.1-7) STARTUP OF THE PRESSURIZED LOW TEMPERATURE REDUCTION REACTOR. Raupers, C. A.; Trapp, J. H. (National Lead Co. of Ohio, Cincinnati).

A summary of operating experience with the pilot plant pressurized, low-temperature (PLT) reduction facility is presented. Major development problems encountered and their solutions are discussed. Green salt was reduced by Mg in at inert atmosphere at 75 psig and ~2300°F. (auth)

39001 (RL-SEP-595) POTENTIAL FOR CONVERSION OF REDOX PLANT FOR POWER FUELS PROCESSING. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). July 15, 1965. Contract AT(45-1)-1350. 201p. Dep. CFSTI.

The feasibility for converting the Redox Plant to provide capability for processing fuels from water-cooled power reactors was examined. The fuels considered for processing are zirconium- or stainless steel-clad uranium oxides containing equivalent ^{235}U enrichments up to 5%. Capital costs for conversion of the plant, unit costs for processing fuels of several enrichments, and fixed operating costs are estimated. Cost parameters were investigated for storage of radioactive processing wastes from power fuels in new tanks and the perpetual care of these wastes. The processing of thoria target elements for ^{233}U and thorium recovery was examined. (M.C.G.)

39002 (RLO-1750-22(Vol.2), Paper 1) EXTRACTION OF ZINC FROM SEA WATER. Buffo, Lynn Karen (Oregon State Univ., Corvallis. Dept. of Oceanography). June 1967. 49p. Thesis.

A liquid-extraction procedure for concentration of zinc in sea water was developed. The metal ion in sea water was chelated with sodium diethyldithiocarbamate and extracted into an organic solvent, methyl isobutyl ketone, at the normal pH of sea water. A back-extraction into HCl followed, providing a concentration of 30× for the entire procedure. Filtration was introduced into the procedure to insure that only dissolved forms were extracted and that no influence from particulate matter would be detected. Problems of loss of zinc and/or contamination arose. These were overcome to a great extent by washing all glassware, including the sintered-glass filter holder, in nitric acid and by following the filtration through the glass holder with an acid rinse. Purification of reagents was found necessary. With replicate analyses on a given sea water source, the recovery was 97 ± 2%. On making varying standard additions to subsamples of sea water, the calculated recovery was 97 ± 5.4%. The contamination figure for the extraction process ranged from zero to 0.8 ppb in the original sea water sample. With filtration, an overall median contamination of 1.4 ± 1 ppb was determined. (auth)

39003 (UCRL-14494) COACH PROCESSING: A STUDY OF PROCESSES FOR CONCENTRATING ACTINIDES FORMED IN A NUCLEAR DETONATION IN A SALT MEDIUM. Elson, R.; Boardman, C.; Cooperstein, R.; (and others) (California Univ., Livermore. Lawrence Radiation Lab.). May 25, 1965. Contract W-7405-eng-48. 275p. Dep. CFSTI.

The Coach processing effort was designed to determine the technical feasibility of separating about 1 g of transcurium actinides from an estimated 30,000 to 50,000 tons of impure salt, resulting from a nuclear detonation in the Solado formation near Carlsbad, New Mexico. The association of actinides with specific compounds was investigated in an attempt to devise specific separation procedures based on the chemistry of these compounds. Since >88% of the material originally present was soluble in water, an efficient and economical means of removing the bulk of material was an aqueous leach, leaving the actinides in the water-insoluble residue. The actinides, along with most of the water-insoluble residue, could then be solubilized by treatment with acid. The actinides were then concentrated with dioctylpyrophosphoric acid, since this acid is relatively insensitive to interfering ions and has a high solvent power for the actinides. A program was undertaken to test various unit operations on a small engineering scale. Debris from the Gnome event, detonated in the same location as that planned for Coach, served as material for most of the studies reported. Topics covered include: aqueous processes; high-temperature, molten-salt processes; bench-scale engineering tests; preliminary cost estimation; association of actinides in ore; use of the transplutonics as neutron sources; and determination of Pu, Am, and Cm. (M.C.G.)

39004 (WAPD-Trans-69) MACROMOLECULAR ORGANIC-COMPLEX COMPONENTS FOR CONCENTRATING URANIUM AND COPPER IN SEA WATER. Bayer, Ernst; Fiedler, H. Translated by Walter Oppenheimer for Westinghouse Electric Corp., Bettis Atomic Power Lab., West Mifflin, Pa., from Angew. Chem., 72: 921(1960). 2p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

Macromolecular complex-forming compounds, prepared from dicarbonyl compounds, polyamino phenols, and polyacrylic acid esters were used in extraction columns to concentrate copper and uranium in sea water. Analyses indicated 4.5 to 5 μg Cu and 0.5 μg U in 1 liter of sea water. Both ions were concentrated 100,000-fold. (M.C.G.)

39005 EXTRACTION METHODS IN HYDROMETALLURGY OF NONFERROUS AND RARE METALS. Kuznetsov, V. A. pp 5-66 of Metallurgiya Tsvetnykh i Redkikh Metallov, 1965. Ageev, N. S. (ed.). Moscow, Institut Nauchnoi Informatsii, 1966. (In Russian).

A brief review is given of the extraction methods and their uses in separation of light, heavy, rare, and radioactive metals. Extraction of Be, Al, Sr, Ru, Ce, Ga, In, Ta, Y, La, Yb, Zr, Hf, Nb, Te, V, Mo, W, Re, Th, Pr, U, Pu, and Pb by various extraction agents is described. (173 references) (R.V.J.)

39006 ELECTROPHORETIC METHOD FOR SEPARATION OF MICROQUANTITIES OF Pm, Pu, Am, AND Cm FROM MACROQUANTITIES OF U. Marku, G.; Marku, T. pp 359-62 of Omagiu Acad. Prof. Raluca Ripan. Bucharest, Editura Academiei Republicii Socialiste Romania, 1966. (In Russian).

Studies were made of the ion mobility of Pm, Pu, Am, Cm, and U in acetic acid at various concentrations and various pH. The optimal conditions were found for separating Pm, Pu, Am, and Cm from macroquantities of uranium. It was found that the presence

of macroquantities of Eu increased the efficiency of separation of Am and Cm from U. (tr-auth)

39007 SEPARATION OF ZIRCONIUM(IV) AND THORIUM(IV) FROM EACH OTHER AND FROM NUMEROUS METAL IONS BY AQUEOUS PAPER CHROMATOGRAPHY. Qureshi, Mohsin; Khan, Fahmida (Aligarh Muslim Univ., India). Anal. Chem., 39: 1329-31(Sept. 1967).

The separation of thorium from various metal ions including Fe, Al, Ti, UO_2, La, Ce(III), and Ce was accomplished using 40% HNO, saturated with oxalic acid. The separation of Zr and Th in the presence of various cations and anions was achieved in 65 min. Phosphate and molybdate did not interfere. The procedure also separated Zr–Th–Ti. The use of $HCl–H_3PO_4$–water (10:1:9) by volume was successful for the separation of Zr from numerous metal ions including Th, V, Cu, Fe, and Ce. The same system was found useful for the separation of Zr and Th in the ratio of (1:100) and (100:1). In both solvent systems mineral acid concentrations are high and the pH values are consequently very low. Under these circumstances the concentration of the precipitating ion, oxalate or phosphate, is extremely small and only the Th or Zr is selectively precipitated. The study showed that selective precipitation reactions can be made almost specific when they are suitably modified and applied on paper. All separations obtained for zirconium nitrate were also obtained for zirconyl chloride and hafnyl sulfate. (D.H.M.)

39008 PURIFICATION OF TRANSPLUTONIUM ACTINIDES PRODUCED IN UNDERGROUND THERMONUCLEAR EXPLOSIONS. Wolfsberg, K.; Daniels, W. R.; Ford, G. P.; Hitchcock, E. T. (Los Alamos Scientific Lab., N. Mex.). Nucl. Appl., 3: 568-74(Sept. 1967). (LA-DC-8042).

Study of heavy elements produced in underground thermonuclear explosions requires the separation of trace quantities of actinide elements from several hundred to several thousand grams of fused rock containing the products from about 10^{17} fissions. After the sample is pulverized and dissolved in HNO_3, $HClO_4$, and HF, fluoride insoluble salts are precipitated. These are redissolved, and the actinides and lanthanides are extracted into tributyl phosphate from a solution that is highly salted with $Al(NO_3)_3$. The actinides and lanthanides are back-extracted into water and then extracted into bis(2-ethylhexyl) ester of phosphoric acid. Recovery from bis(2-ethylhexyl) phosphate is achieved by esterification with decanol. The actinides are separated from the lanthanides by elution from a cation-exchange resin column with an ethanol-hydrochloric acid solution. Individual actinides are separated by elution from a cation-exchange resin column with α-hydroxyisobutyric acid. (auth)

39009 EXTRACTION OF LANTHANIDES BY MEANS OF THENOYLFLUORACETONE. 2ND COMMUNICATION. Genow, L.; Kassabow, G. (Chemical Tech. Inst., Sofia-Darwenitza, Bulgaria). Monatsh. Chem., 98: 364-8(1967). (In German).

The distribution of $Nd(NO_3)_3$, $Sm(NO_3)_3$, $Gd(NO_3)_3$, and $Tm(NO_3)_3$ between an aqueous solution with an ionic strength of 0.1 and a 0.2M benezene solution of 2-thenoyltrifluoroacetone was investigated. With increasing atomic number of the extracted element, the extraction equilibrium constant also increased. The functional dependence of the log of this constant on the potential of the metal ion could, with first approximation, be assumed to be linear. On the basis of these investigations, thenoyltrifluoracetone is recommended for separating the lanthanides. (BBB)

39010 OXYGEN ISOTOPE FRACTIONATION BETWEEN HOST AND EXSOLVED PHASES IN PERTHITE. Schwarcz, Henry P. (McMaster Univ., Hamilton, Ont.). Geol. Soc. Amer., Bull., 77: 879-82(Aug. 1966).

By measuring the isotopic composition of the oxygen of host and exsolved phases of a perthite, attempts were made to distinguish between different models for perthite formation. Oxygen isotope analyses of exsolved plagioclases and host microcline from 3 granitic perthites showed no significant differences between host and exsolved phase. This is in agreement with the hypothesis of exsolution of alkali ion diffusion alone. However, the precision of analysis was insufficient to rule out reconstruction of the feldspar lattice and equilibration between Na-rich and K-rich phases suring exsolution. It appears that if any isotopic fractionation between host and exsolved feldspar exists it cannot be resolved by present analytical methods. (BBB)

39011 SOLVENT EXTRACTION OF FISSION PRODUCTS. Miller, F. J. Isotop. Radiat. Technol., 4: 214-22(Spring 1967).

The extraction of useful radioisotopes from solutions accumulated in the processing of spent fuel elements during recovery of uranium and plutonium is important in the economic reclamation of fission products and storage of the process solutions. The basic phenomena of solvent extraction are reviewed, and the necessary equipment is discussed briefly. As a typical example of the reclamation of a commercially useful radioisotope, the solvent extraction of ^{90}Sr with di-(2-ethylhexyl) ester of phosphoric acid diluted with kerosene is described in detail. (auth)

39012 STUDY OF AQUEOUS SOLVENTS FOR PAPER CHROMATOGRAPHIC SEPARATION OF CATIONS: DETERMINATION OF IRON(III). Qureshi, Mohsin; Khan, Fahmida (Muslim Univ., Aligarh, India). Chem. Anal., 56: 44-8(July 1967).

Forty-five aqueous systems were studied for use as developing solvents in the paper chromatographic separation of cations. The solvents included as components, acetic acid–ammonium chloride, hydrochloric acid–ammonium chloride, acetic acid–ammonium acetate, acetic acid–sodium acetate, and sodium hydroxide–hydrogen peroxide. The separation of iron(III) from calcium, barium, cobalt(II), nickel(II), copper(II), silver(I), zinc, cadmium lead(II), and arsenic(III) was effected using 1:1 aqueous ammonia with ammonium chloride. When the same strip was then developed with 9:1 0.2 molar sodium hydroxide and 20% hydrogen peroxide, iron(III) was separated from strontium, uranium(IV), vanadium(IV), chromium(III), and aluminum. In the separation and determination of 300 μg of iron(III), the recovery ranged from 290 to 320 μg, with an average of 309 μg. (J.G.B.)

39013 SEPARATION OF THE ISOTOPES OF URANIUM BY THE SEPARATION NOZZLE PROCESS. Becker, E. W.; Bier, K.; Bier, W.; Schuette, R.; Seidel, D. (Technische Hochschule, Karlsruhe, Ger.). Angew. Chem. Int. Ed. Engl., 6: 507-18(June 1967).

The separation nozzle process is based on the partial spatial separation of components of different mass in an expanding supersonic jet stream. The process is of special interest for the separation of uranium isotopes. Details of a systematic experimental determination of the most favorable operating conditions for such a separation are given and the construction and testing of a closed circulation system, the basic unit of a ten membered pilot cascade separator for uranium isotope separation, is described. The optimum values of the specific cost factors obtained experimentally for the separation nozzle process are compared with the corresponding values estimated for the gaseous diffusion process. (auth)

39014 SEPARATION OF AMERICIUM FROM RARE EARTHS BY REVERSE-PHASE PARTITION CHROMATOGRAPHY. Barbano, P. G.; Rigali, L. (CAMEN, Pisa, Italy). J. Chromatogr., 29: 309-11(July 1967).

Reversed-phase partition chromatography using quaternary ammonium salts was used to separate americium(III) from the rare earths. Aliquat-336 (methyl-tri(n-alkyl)ammonium, principally octyl and decyl) in the thiocyanate form was used as extractant. A rapid separation of americium from the rare earths was obtained using NH_4SCN and H_2SO_4 as eluents. A selective elution of La, Ce, Pm, Eu, Tm, and Am was obtained by gradient elution with thiocyanate solutions of decreasing concentration. A group separation of americium from the rare earths was also obtained using an ascending chromatography technique with paper strips treated with Aliquat-336 in the thiocyanate form and a developing solution consisting of NH_4SCN and H_2SO_4. (D.H.M.)

39015 A RAPID METHOD FOR THE CARRIER-FREE DETERMINATION OF INDIVIDUAL RARE EARTHS BY ION EXCHANGE AT ROOM TEMPERATURE. Foti, S. C.; Wish, L. (Naval Radiological Defense Lab., San Francisco). J. Chromatogr., 29: 203-9(July 1967).

The time for separations of rare earth radionuclides by ion exchange was reduced to 14 hr by the use of one tenth of the concentration of the eluant (α-hydroxyisobutyric acid) and a higher pH. This reduction in time of separations will make it possible to study shorter-lived rare earth radionuclides (^{156}Sm, ^{145}Pr, ^{141}La). In addition, more analyses can now be performed in a given period of time. (auth)

39016 RADIO-GAS-CHROMATOGRAPHIC ANALYSIS OF ^{11}C-LABELED ISOTOPIC ETHYLENE AND ACETYLENE. Ache, Hans J.; Wolf, Alfred P. (Brookhaven National Lab., Upton, N. Y.). Z. Anal. Chem., 230: 19-28(1967). (In German). (BNL-10660).

The gas-chromatographic separation of isotopic ethylenes, C_2H_4, C_2H_3D, and $C_2H_2D_2$ was achieved by using highly efficient silver nitrate/ethylene glycol columns in combination with a recycling method. The analysis of the three isotopic acetylenes: HC≡CH, HC≡CD, and DC≡CD was accomplished by reducing these compounds with chromous chloride solution to the corresponding ethylenes prior to the gas-chromatographic separation. (No isotopic exchange occurred during the reduction process.) One of the advantages of the method is that separations of the isotopic compounds are obtained in a much shorter time than with the conventional one-column technique, which is of great importance in the radio-gas-chromatography of isotopic molecules labeled with short-lived radioisotopes. (auth)

39017 AUGMENTING THE SEPARATION OF GADOLINIUM AND EUROPIUM AND EUROPIUM AND SAMARIUM MIXTURES IN ION EXCHANGE ELUTIONS WITH EDTA. Powell, J. E.; Burkholder, H. R. (Iowa State Univ., Ames). J. Chromatogr., 29: 210-17(July 1967). (IS-1492).

Scrutiny of thermodynamic data and proposed models for the hydrated ethylene–diaminetetraacetato (EDTA) chelates of the rare earths suggested a rather obvious means of improving displacement chromatographic separations of Gd–Eu and Eu–Sm mixtures on cation exchange columns. Increasing the operating temperature from 25 to 92°C was found to effect an increase in the Gd–Eu separation factor from 1.1 to 1.47 ± 0.07 and the Eu–Sm separation factor from 1.4 to 1.8, presumably by destroying a degree of internal hydrogen bonding which occurs to a varying extent in the case of the less constrained lighter rare earth EDTA chelates at room temperature. Apparently this type of internal hydrogen bonding is not possible in the case of the smaller heavier rare earth EDTA chelates (Gd through Lu). This effect was correlated with a similar trend noted in the stability behavior of terbium, dysprosium and holmium β-hydroxyethylethylenediaminetriacetates with increased temperature. (auth)

39018 SEPARATION OF HYDROGEN ISOTOPES BY GAS–SOLID CHROMATOGRAPHY. Conti, M. L.; Lesimple, M. (CEN, Gif-sur-Yvette, Essone, France). J. Chromatogr., 29: 32-43 (July 1967).

Molecular Sieve 4A can be used as the stationary phase in the gas–solid chromatographic separation of hydrogen isotopes and isomers: the separation is studied as a function of the different factors involved (temperature, flow rate, activation of the stationary phase). From the determination of the specific retention volumes as a function of temperature it was possible to calculate the heats of absorption of hydrogen deuteride, hydrogen tritide, deuterium, deuterium tritide, and tritium. (auth)

39019 RADIOCHEMICAL SEPARATION OF STRONTIUM BY ISOTOPIC EXCHANGE. Qureshi, I. H.; Shahid, M. S.; Hasany, S. M. (Atomic Energy Centre, Lahore). Talanta, 14: 951-6 (Aug. 1967).

Isotopic exchange has been used for the rapid separation of minute quantities of radiostrontium. A number of variables such as agitation time, concentration of strontium in both phases, mode of preparation, and aging of the precipitates, were studied and optimized. With an optimized procedure, exchange yields of 96 and 94%, respectively, were obtained when strontium sulphate and strontium oxalate precipitates were used for the exchange. Decontamination studies made with radioactive tracers of 15 elements showed that the sulphate precipitate is more selective than the oxalate, most of the elements showing <1% contamination, except ^{140}Ba–^{140}La and ^{110}Ag, which showed high contamination. This simple procedure has also been applied for the determination of radioactive strontium in rainwater samples. (auth) (UK)

39020 RADIOCHEMICAL SEPARATIONS USING THE RING OVEN METHOD. II. THE SYSTEM $^{99}Mo/^{99m}Tc$. Klockow, D. (Univ., Freiburg i. B.). Talanta, 14: 817-21(July 1967). (In German).

The separation of ^{99}Mo and ^{99m}Tc by the ring-oven technique is described. The separation is best carried out on round papers impregnated with Prussian Blue or with manganese dioxide, when the molybdenum is fixed in the center of the paper and the technetium is concentrated with 70 to 90% yield in the ring. Decontamination factors of $\geq 10^3$ were obtained. ^{99m}Tc formed after the separation can be further leached from the parent nuclide. The half-life of ^{99m}Tc was found to be 6.06 ± 0.05 hr. (auth) (UK)

39021 METHOD OF DECANNING NUCLEAR FUEL ELEMENTS. (to CEA). French Patent 1,438,507. Apr. 4, 1966. Filed Mar. 31, 1965.

Mg cans are removed from U fuel elements by dissolution in Hg at room temperature. The dissolution can be accelerated by application of ultrasonics. The Hg is recovered from the Hg–Mg amalgam by distillation, treatment with nitric acid, or oxidation with air. (NPO)

39022 METHOD AND APPARATUS FOR DECANNING NUCLEAR FUEL ELEMENTS BY VACUUM SUBLIMATION. (to CEA). French Patent 1,212,159. Oct. 19, 1959. Filed Aug. 30, 1958.

Mg cannings are removed from fuel rods by means of vacuum sublimation. The apparatus for carrying out this process consists of a vertical, rotating drum, provided at its perifery with seven tubular, induction-heated furnaces. The drum is mounted in an evacuated chamber, which is provided with an apparatus for successively charging the furnaces with a fuel rod. A rotating plate-shaped condenser is mounted over the drum. One revolution of the drum suffices for removing the can, after which the bare U rod is replaced by another fuel element. The Mg metal sublimes out of the furnaces, condenses on the condenser, and is continuously removed from the condenser by means of a scraper. (NPO)

39023 METHOD OF PHOSPHORUS EXTRACTION. (to CEA). French Patent 1,406,025. June 8, 1965. Filed June 4, 1965.

Phosphorus-32 is extracted from neutron-irradiated S by contacting the molten S with a selective absorbent, e.g., Pyrex glass, SiO_2, Al_2O_3 or stainless steel; separating said adsorbent, and electing the adsorbed P with HCl + H_2O_2 or NaOH. (NPO)

39024 METHOD OF DIRECT PLUTONIUM RECUPERATION FROM IRRADIATED NUCLEAR FUEL. (to Japan Atomic Energy Research Inst.). French Patent 1,404,876. May 24, 1965. Priority date Feb. 10, 1964, Japan.

Irradiated nuclear fuel (U, UO_2) is repeatedly subjected to an oxidation-reduction cycle, consisting of oxidation with O_2 followed by reduction with H_2. This treatment results in a complete disintegration of the fuel, which is further pulverized and extracted with trilaurylamine, trioctylamine, or cyclohexyldilaurylamine nitrate, diluted with kerosene and octyl alcohol. Pu is precipitated from the aqueous extract by means of oxalic acid. (NPO)

39025 IMPROVEMENTS IN THE DISSOLUTION OF ALUMINUM CANS. (to U.S. Atomic Energy Commission). French Patent 1,308,494. Sept. 24, 1962. Priority date Dec. 28, 1960, United States.

Al cans are removed from fuel elements by dissolving them in 2 to 7M HNO_3, adding 0.001 to 0.01M $Hg(NO_3)_2$ as a catalyst and, as an antisynergistic agent, $Ni(NO_3)_2$ in a molar ratio to the $Hg(NO_3)_2$ of above 2½. (NPO)

39026 REMOVAL OF STAINLESS STEEL CANS. (to U.S. Atomic Energy Commission). French Patent 1,392,911. Feb. 8, 1965. Priority date May 3, 1963, United States.

Stainless steel cans are removed from U fuel elements by contacting the elements in a fluidized bed of Al_2O_3 containing 1% AlF_3 with oxygen at 675 to 750°C. Prior to the decanning operation the bed is activated with F_2 at 400 to 450°C. After the oxidation the bed is again cooled to 400 to 450°C, and the bare U converted to UF_6 by means of F_2 gas. (NPO)

39027 METHOD OF DECANNING FUEL ELEMENTS AND APPARATUS FOR CARRYING OUT SAID METHOD. (to CEA). French Patent 1,430,314. Jan. 24, 1966. Filed Jan. 20, 1965.

An apparatus for continuously removing fuel element cans by means of an acid comprises two parallel, elongated recipients, mounted at an angle of 30°, which communicate at their lower ends. The upper recipient is provided at its upper end with an acid inlet and a hopper for the introduction of canned fuel elements while the lower recipient is provided at its upper end with an inlet for rinsing liquid at a discharge means for bare fuel elements. The transport of the fuel elements through both recipients is effected by means of conveyer screws. Both recipients communicate at their lower ends with a vertical tower through which all liquids are discharged. Solid wastes are collected in a removable basket placed at the bottom of the tower. (NPO)

39028 METHOD OF PURIFYING AND DECONTAMINATING ORGANIC SOLVENTS. (to CEA). French Patent 1,425,294. Dec. 13, 1965. Filed Aug. 17, 1964.

Spent trilaurylamine, used for purifying Pu, is decontaminated with a mixture of acid-activated colloidal clay (e.g., bentonite) and activated carbon. (NPO)

EARTH SCIENCES

Geology

Refer also to abstracts 39050, 39051, 39053, 39063, and 39167.

39029 (AERE-R-5368) A SURVEY OF THE APPLICATION OF RADIATION TECHNIQUES IN OIL AND MINERAL BOREHOLES. Clayton, C. G. (United Kingdom Atomic Energy Authority, Wantage (England). Research Group). Feb. 1967. Revised July 1967. 74p. Dep. CFSTI. UK 10s.

The application of radiotracers and radioisotope instruments in the exploration and exploitation of oil and gas reserves and in mineral prospecting was surveyed. In the oil industry, the most important techniques include natural-γ logging to identify underground lithology, and (γ,γ), (n,n) and (n,γ) logging to determine mineral density and porosity and water and oil saturation levels. The neutron die-away method is now in wide use to locate and follow oil/water interfaces. Nuclear geophysical methods, especially selective (γ,γ) logging, neutron activation logging and x-ray fluorescence techniques are currently being used and developed for mineral prospecting. This survey emphasizes the limitations of the techniques, and comments on current theoretical treatments have been included. (auth)

39030 (COO-689-76) CORRELATION AND CHRONOLOGY OF ORE DEPOSITS AND VOLCANIC ROCKS. Annual Progress Report. Damon, Paul E. (Arizona Univ., Tucson. Geochemical Section). June 1967. Contract AT(11-1)-689. 269p. Dep. CFSTI.

Modifications to the Ar analysis system are reported. A new style furnace was installed that decreases cleanup time. The flame photometer for K analyses was equipped with regulators to reduce flow and pressure fluctuations in the gas–air system. Improvements to the He analysis equipment are described. Improvements related to equipment and procedures used in radiometric analyses are also described. Methods for determining Rb and Sr by x ray fluorescence were developed. Results of areal and topical studies are reported on ^{40}Ar excess in pegmatites, excess ^{40}Ar in volcanic rocks, Chiricahua ash-flow field, Del Bac Hills volcanics, Sr isotopic distribution in Central American ignimbrites, volcanic chronology of southeastern Arizona and southwestern New Mexico, and Pre-late-Jurassic age of the Recreation Red Beds. Trace element studies on feldspars from Amelia, Virginia are reported. Information is included on ultrasonic purification of minerals and on chemical petrography of samples from the Roskruge Mountains. Separate abstracts were prepared for information contained in eleven appendixes and two reprints used to summarize previous work. (J.R.D.)

For abstracts of individual papers see: 39031–39042 and 39063.

39031 (COO-689-76, App.A-I) THE PROBLEM OF EXCESS OF ^{40}Ar IN VOLCANIC ROCKS. Damon, P. E.; Laughlin, A. W.; Percious, J. K. (Arizona Univ., Tucson. Geochemical Section). 22p. (COO-689-77).

Results of recent investigations demonstrated that under favorable conditions it is possible to obtain reasonable ages for Pleistocene volcanic rocks by the K–Ar method. Experimental precision in determining the ratio of radiogenic argon-40 to potassium-40 is not necessarily the ultimate limitation on the meaningful dating of these rocks. This limit will probably be set in many cases by the phenomenon of excess argon-40 in minerals and the inheritance of argon-40 in xenolithic materials. It is apparent that excess argon-40 in minerals from intrusive environments is an ubiquitous phenomenon. Results of measurements indicate typical levels of around 10^{-10} moles/gram for the major rock-forming feldspar minerals. Retention of only 1% of this amount presents a significant limitation to dating of late Pleistocene volcanic rocks. Measurements on large phenocrysts of plagioclase feldspar from the Black Point Basalt demonstrate that this amount can be retained (2×10^{-12} moles/gram). The critical factors in outgassing of volcanic minerals are the cooling rate and the diffusion parameters. Fine-grained minerals are most suitable. Rapidly chilled boundary zones should be avoided. Measurements on cogenetic nonpotassic-potassic minerals can aid in the evaluation of errors due to the phenomenon of excess argon-40. (auth)

39032 (COO-689-76, App.A-II) POTASSIUM–ARGON DATING OF IGNEOUS AND METAMORPHIC ROCKS WITH APPLICATIONS TO THE BASIN RANGES OF ARIZONA AND SONORA. Damon, Paul E. (Arizona Univ., Tucson. Geochemical Section). 71p. (COO-689-78).

The merits and problems associated with the Ar–K dating method as applied to igneous and metamorphic rocks are discussed. It is concluded that with its limitations, the method is a powerful chronological tool for all of geologic time. (J.R.D.)

39033 (COO-689-76, App.A-III) GEOCHRONOLOGY OF THE EMPLACEMENT, ENRICHMENT AND PRESERVATION OF ARIZONA PORPHYRY COPPER DEPOSITS. Livingston, Donald E.; Mauger, Richard L.; Damon, Paul E. (Arizona Univ., Tucson. Geochemical Section). 18p. (COO-689-80).

The K–Ar method of geochronometry has, with slight modifications, confirmed the age and stratigraphic position of the porphyry copper deposits as described by H. Schmitt. Fifteen of the sixteen known porphyry copper deposits in Arizona are intimately related to the late Cretaceous to early Tertiary plutons of the Laramide (75 to 55 m.y.) igneous epoch. Only Bisbee (~170 m.y.) is related to a distinctly different igneous epoch. All of the Laramide deposits are either covered by, partly covered by, or located within six miles of overlying later Tertiary sedimentary and/or volcanic rocks. Where dated, the younger volcanic rocks belong to the Basin and Range (35 to 15 m.y.) igneous epoch. Most deposits show evidence of extensive erosion and supergene enrichment prior to burial in mid-Tertiary time. The deposit at Bisbee was eroded and enriched prior to burial in early Cretaceous time. The Laramide porphyry copper deposits appear to have developed during a period of volcano-plutonic activity followed by a period of extensive erosion and supergene enrichment during which some or all of the contemporaneous volcanic rocks were eroded away. These deposits were then preserved from complete erosion by burial beneath widespread sedimentary and/or volcanic rocks of mid-Tertiary age. As the modern (post-Miocene) stream regime cut into the tectonically deformed pre-mid-Tertiary erosion surface, these deposits were again exposed and eroded and made accessible for exploitation. The same principle holds for the older deposit at Bisbee. Detailed knowledge of the mid-Tertiary rocks is essential to the exploration for this type of concealed deposit. Detailed field mapping and K–Ar dating can be coupled with paleontology and physical stratigraphy to limit the regions of possible occurrence of buried porphyry copper deposits. (auth)

39034 (COO-689-76, App.A-VI) POTASSIUM–ARGON DATES FROM TOQUEPALA AND MICHIQUILLAY, PERU. Laughlin, A. W.; Damon, P. E.; Watson, B. N. (Arizona Univ., Tucson. Geochemical Section). 10p. (COO-689-83).

Three K–Ar dates have been obtained on rocks associated with copper mineralization in Peru. A maximum age of 58.7 ± 1.8 m.y. (Laramide) is assigned to the Toquepala deposit while at the Michiquillay prospect, mineralization apparently occurred at 20.6 ± 0.6 m.y. (mid-Tertiary). Michiquillay is thus the youngest dated copper porphyry. The relative youth of this porphyry probably explains the presence of but a thin blanket of secondary enrichment. (auth)

39035 (COO-689-76, App.A-V) STRONTIUM ISOTOPE RATIOS IN VOLCANIC ROCKS OF THREE ISLAND ARC AREAS. Pushkar, Paul (Arizona Univ., Tucson. Geochemical Section). 22p. (COO-689-82).

The initial $^{87}Sr/^{86}Sr$ ratios in several non-ignimbrite calc-alkaline volcanic rocks from Saipan, Central America, and the Lesser Antilles, with two exceptions, are all indistinguishable from .7040, the most common value for this ratio observed in young volcanic rocks. The same ratio is found in several tholeiitic lavas in the northern Mariana, the Bonin, and the Izu Islands as well. This suggests that all these lavas are found in a source area in the upper mantle, or possibly in basaltic rocks of the oceanic crust and lower continental crust. Formation of the calc-alkaline series by contamination of such magmas with continental material is not required by the isotope evidence, but may take place to the extent that the contaminating radiogenic strontium in the continental material can be diluted beyond detection by magmatic strontium. The calc-alkaline series cannot form by direct melting of continental rocks. Two lavas in the Lesser Antilles were erupted with initial $^{87}Sr/^{86}Sr$ ratios markedly greater than .7040. It is suggested that the Puerto Rico Trough became filled with sedimentary material made up of authigenic carbonate-rich material and continental detritus deposited by the Orinoco River. This material was then buckled to form the Barbados Ridge, possibly by convective currents in the upper mantle, and some of it became incorporated in magma chambers. (auth)

39036 (COO-689-76, App.A-VII) EXCESS RADIOGENIC ARGON IN PEGMATITE MINERALS FROM ELBA ISLAND. Laughlin, A. William (Arizona Univ., Tucson. Geochemical Section). 6p. (COO-689-84).

Results of age analyses of albite and tourmaline minerals from young pegmatite of Monte Capanne, Elba are presented. (J.R.D.)

39037 (COO-689-76, App.A-VIII) SUMMATION OF THE PROCEEDINGS OF THE INTERNATIONAL ATOMIC ENERGY AGENCY SYMPOSIUM ON RADIOACTIVE DATING AND METHODS OF LOW-LEVEL COUNTING, MONACO, MARCH 2-10, 1967. Damon, Paul E. (Arizona Univ., Tucson. Geochemical Section). 2p. (COO-689-85).

In summarizing the proceedings it was noted that discussions were included concerning geochemistry and cosmochemistry of radiocarbon, extension of tracer techniques, age estimation, meteoritics, and new analytical techniques. (J.R.D.)

39038 (COO-689-76, App.A-IX) APPLICABILITY AND ACCURACY OF QUATERNARY RADIOMETRIC DATING. Damon, Paul E. (Arizona Univ., Tucson. Geochemical Section). 2p. (COO-689-86).

It was noted that ^{14}C method is useful for dating events which have occurred during the past 50,000 yrs. U disequilibrium methods of dating, although not very precise, are useful for dating deep-sea sediments between about 50,000 to 300,000 yrs ago. The most promising chronological approach is the K-Ar dating of volcanic rocks when used in conjunction with paleomagnetic measurements. (J.R.D.)

39039 (COO-689-76, App.A-X) RADIOMETRIC DATING OF IDAHO BATHOLITH PORPHYRIES. Percious, J. K.; Damon, P. E.; Olson, H. J. (Arizona Univ., Tucson. Geochemical Section). 6p. (COO-689-87).

Samples of the Idaho Batholith and intrusives into the batholith were dated by the argon/potassium method. The area from which the samples were taken lies within the Idaho-Montana porphyry belt between Boise Basin and the Casto Quadrangle. Dates as established by the K-Ar method are tabulated and discussed. (J.R.D.)

39040 (COO-689-76, App.A-XI) GEOCHEMICAL DATING STUDIES WITHIN THE BASIN AND RANGE PROVINCE OF SONORA. Damon, Paul E. (Arizona Univ., Tucson. Geochemical Section). 5p. (COO-689-88).

A brief summary of the geochemical dating studies within the Basin and Range Province of Sonora is presented. Data on K-Ar dates for Sonoran igneous and metamorphic rocks are tabulated. A location map is also included. (J.R.D.)

39041 (COO-689-76, Reprint I) K-Ar CHRONOLOGY OF THE TUCSON MOUNTAINS PIMA COUNTY, ARIZONA. Bikerman, Michael; Damon, Paul E. (Arizona Univ., Tucson, Geochemical Section). 10p. (COO-689-5).

Published in Geol. Soc. Amer., Bull., 77: 1225-34(1966).

Data on the ages of igneous rocks in the Tucson mountains are tabulated and discussed. The dated rocks in these mountains are grouped as those of the Laramide interval (57 to 75 m.y.) and those of the mid-Tertiary organic period (20 to 30 m.y.). (J.R.D.)

39042 (COO-689-76, Reprint II) POTASSIUM ARGON DATING. Schaeffer, O. A.; Zaehringer, J. (eds.) (Arizona Univ., Tucson. Geochemical Section). 2p. (COO-689-79).

Published in Trans. Amer. Geophys. Union, 48: No. 1, 274-5 (1967).

A book on potassium-argon dating is reviewed. It is noted that the book coverage is reasonably comprehensive. In spite of editorial shortcomings the book is recommended to all scientists interested in this method of radioactive dating. (J.R.D.)

39043 (NYO-3629-7) DIRECT DATING OF FOSSILS BY THE HELIUM-URANIUM METHOD. Schaeffer, O. A. (State Univ. of New York, Stony Brook, Dept. of Earth and Space Sciences). Nov. 8, 1966. Contract AT(30-1)-3629. 16p. (CONF-670309-3). Dep. CFSTI.

From IAEA Symposium on Radioactive Dating and Methods of Low-Level Counting, Monaco, France.

The He-U method of dating is discussed including the history and the pitfalls in using the method. It is necessary to be sure of He retention and to know the chemical history of the U. The He-U method is applicable to dating fossil carbonates, raised beaches, ocean cores, and events in the pleistocene and pliocine. A fossil carbonate shell or coral contains enough K to make an Ar-K determination except for Ar contamination from the atmosphere. U is found in many fossil carbonates in ppM amounts. The U is not in equilibrium with its decay series for certain corals. Initially only ^{238}U, ^{235}U, and ^{234}U was added to the coral with other daughters growing in. This furnishes a method to date carbonates up to ~300,000 years ago. If He is retained in carbonate shells and if the U is a closed system, the He method is applicable from ~100,000 years ago to as old as samples are available. The He-U method will furnish a check on the disequilibrium in the U decay series dates and extend the range of the method beyond the 300,000 year range. (F.S.)

39044 (RLO-1750-22(Vol.2), Paper 2) VERTICAL DISTRIBUTION OF RADIOACTIVITY IN THE COLUMBIA RIVER ESTUARY. Hanson, Peter James (Oregon State Univ., Corvallis, Dept. of Oceanography). June 1967. 77p.

Thesis.

In a preliminary investigation of certain γ emitting radionuclides in the Columbia River Estuary, a system was designed for the collection of water samples and the simultaneous in situ measurement of salinity and turbidity. Salinity and temperature were measured by a portable battery-operated induction salinometer and turbidity by a self-contained transmissometer indicating light transmission. Preliminary measurements of dissolved and suspended particulate radioactivity were made and correlated with salinity and turbidity. Particulate ^{51}Cr and ^{65}Zn increase with depth and the percent particulate correlates with turbidity. Dissolved ^{51}Cr appears to vary inversely with salinity but ^{65}Zn shows no linear relationship to salinity. (F.S.)

39045 (UCRL-50142) LITHOLOGY AND GEOPHYSICAL PROPERTIES OF THE "GREELEY" MEDIUM. Meyer, G. Lewis; Rambo, John (California Univ., Livermore. Lawrence Radiation Lab.). Oct. 25, 1966. Contract W-7405-eng-48. 37p. Dep. CFSTI.

The Greeley experiment is located on Pahute Mesa, Area 20, of the Nevada Test Site. Two exploratory holes penetrated volcanic rocks of Tertiary age consisting of interbedded welded tuffs, zeolitized tuffs, and rhyolites. Interpretations of the lithology and geophysical properties of the Greeley medium were made from drill cuttings, core, hydrologic tests, petrographic analysis, and an extensive suite of geophysical logs. These different classes of information all seem valid and correlate well. The medium at 3600 to 4200 ft is interpreted as being relatively homogeneous, isotropic, and unfractured. Average properties of the medium include porosity, 30%; permeability, 2.5 millidarcies; density, 2.16 g/cm^3; temperature, 102°F; compressional velocity, 10,000 fps; and shear velocity, 4700 fps. The special problems incurred during geophysical logging in the volcanic rocks of the Nevada Test Site are discussed briefly for each type of log. (auth)

39046 RADIOACTIVITY OF UPPER MESOZOIC GRAYWACKES IN THE NORTHERN COAST RANGES, CALIFORNIA. Wollenberg, Harold A. (Univ. of California, Berkeley); Smith, Alan R.; Bailey, Edgar H. J. Geophys. Res., 72: 4139-50 (Aug. 15, 1967).

Traverses across the Coast Ranges north of San Francisco were made to measure the field gamma radioactivity and to sample graywackes of the Franciscan formation, its coastal belt unit, and the great valley sequence. In the laboratory, specimens were analyzed for U, Th, and K by gamma spectrometry; K feldspar contents were determined by point-counting stained slabs. The K feldspar content has little effect on radioactivity or heat production of the rock units. Low K feldspar content does not indicate low heat generation; therefore, low-temperature high-pressure metamorphism is not related to K feldspar content. Radioactivity tends to decrease with increasing metamorphic grade. Thorium/uranium ratios fall within the range described by Adams and Weaver as typical of eugeosynclinal sediments and are like Th/U ratios in granitic rocks of the Sierra Nevada, the suggested source area. Uranium, thorium, potassium concentrations of the graywackes are compatible with those of a cratonal source. (auth)

39047 ^{86}Rb AS A TRACER FOR EXCHANGEABLE POTASSIUM IN SOILS. Deist, J.; Talibudeen, O. (Rothamsted Experimental Station, Harpenden, Eng.). Soil Sci., 104: 119-22 (Aug. 1967).

A method using ^{86}Rb-labeled RbCl solution was tested on 4 contrasting soils to determine the amount of fixed Rb^+ adsorbed on cation-exchange sites on soils not accessible to K^+ ions from the kinetics of Rb exchange. The values obtained are closely related to the clay contents of the soils. Rb:K exchange corrected for such fixed Rb gives values for exchangeable K very similar to K^+ exchangeable to N ammonium acetate. It is suggested that ^{86}Rb could be used in experiments lasting 4 to 5 months with plants in the glasshouse to determine the K available to plants, provided the results were corrected for such fixed Rb^+, determined by the simple exchange kinetics experiment described and the results corrected accordingly. (auth)

39048 RETENTION OF ^{65}Zn BY COLUMBIA RIVER SEDIMENT. Johnson, Vernon; Cutshall, Norman; Osterberg, Charles (Oregon State Univ., Corvallis). Water Resour. Res., 3: 99-102(First Quarter 1967).

Cationic ^{65}Zn in effluent waters from nuclear reactors at Hanford, Washington, becomes predominantly associated with particles in the Columbia River. Sedimentation carries ^{65}Zn and other particle-sorbed radionuclides into bottom deposits. Two types of retention were studied by observing the fractions of radionuclides displaced by sea water and by solutions of certain first transition series metals. The first type of interaction is cation exchange; the second is an exchange phenomenon, with the nature of the metal ion playing a major role. Less ^{65}Zn was displaced from the sediments by the interaction of sea water than could be removed by leaching with solutions of certain first transition series metals. This was interpreted to mean that ion exchange is not an important mechanism in the retention of ^{65}Zn in these samples. Instead, much of the ^{65}Zn is held by specific sorption. Neither treatment displaced ^{51}Cr or ^{46}Sc from the sediments, whereas about one-third of the ^{54}Mn was removed upon contact with sea water. The apparent order of effectiveness of Cu^{2+}, Co^{2+}, and Mn^{2+} in displacing specifically sorbed ^{65}Zn paralleled the order of stability of complexes of divalent metal ions. Cation exchange sorption of ^{65}Zn is probably even less important in sea water than in fresh water, because other cations (Na^{+}, Mg^{2+}, etc.) are so abundant in the sea. On the other hand, specific sorption may occur because transition metal ions are generally not abundant in sea water. For this reason, it is especially important to distinguish between nonspecific cation exchange sorption and specific sorption in sea water. (BBB)

39049 INVESTIGATIONS OF THE ^{90}Sr-CONTENTS IN SOILS. Haeussermann, W.; Schreiber, H. (Landwirtschaftliche Hochscule, Stuttgart). Atompraxis, 13: 303-6 (July 1967). (In German).

The results of more than 200 determinations of the ^{90}Sr-contents in soils during 1960 to 1964 down to 20 cm in depth are given. The annual amount of precipitation on the different collection places across the Black Forest ranges from 780 to 2200 mm. The variations in time of the ^{90}Sr activity and the distribution in depth are discussed. (tr-auth)

Meteorology

Refer also to abstracts 39037, 39076, and 39161.

39050 (IS-1647) SURVEY OF ENVIRONMENTAL RADIOACTIVITY FOR PERIOD, JANUARY 1, 1967–JUNE 30, 1967. Voss, Milo D. (Ames Lab., Iowa). Aug. 1967. Contract W-7405-eng-82. 18p. Dep. CFSTI.

The environmental monitoring program of the Ames Laboratory of the USAEC for the Ames Laboratory Research Reactor (ALRR) is given. The environmental program consists of air samples, soil, vegetation, river water, bottom sediment, precipitation, pond water, ALRR outfall, and well water samples. As soil and vegetation samples are collected later in the year (usually August), that data will be reported. The ALRR reached full power as of 7/12/65. As of 12/31/66 the ALRR had generated 11,927 megawatts of heat. A total of 27,606 megawatts of heat has been generated as of 6/30/67. The data indicate that the ALRR has not contributed a significant amount of radioactivity to the environment in the Ames area. The conclusion is reached that radioactivity levels recorded for environmental samples represent background conditions from atmospheric fallout and naturally occurring radioactivity. (auth)

39051 (NP-16878) DATA FROM RADIATION PROTECTION PROGRAMS. Volume 5, Number 5. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.). May 1967. 21p. Dep.

The Canadian radiation protection programs conducted in April 1967 are presented. Data on fallout monitoring of air, rain and snow, foods, soils, and human bone are presented. Data on beta activity in air and precipitation are compared with similar data through 1966. The amounts of ^{137}Cs, ^{89}Sr, and ^{90}Sr in whole milk are tabulated. The results of enviromental monitoring near several Canadian reactors are given. The amount of alpha and beta activity in surface water and air samples is given. The ^{137}Cs, ^{89}Sr, and ^{90}Sr concentrations in surface waters are also tabulated. (L.C.L.)

39052 (NP-16879) ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND AND MEASUREMENTS ON SAMPLES FROM FIJI AND RAROTONGA. Quarterly Report, January–March 1967. (National Radiation Lab., Christchurch (New Zealand)). 12p. (NRL-F-24). Dep.

The monitoring of radioactivity in New Zealand during the first quarter of 1967 is summarized. The following information is presented: location of collection stations, long term and routine measurements taken, hazards assessment, beta activity measurements in air and rainwater, ^{89}Sr and ^{90}Sr measurements in rainwater, and ^{137}Cs, ^{89}Sr, and ^{90}Sr measurements in milk. (L.C.L.)

39053 (NP-16971) DATA FROM RADIATION PROTECTION PROGRAMS. Volume 5, Number 6. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.). June 1967. 24p. Dep.

The Canadian radiation protection programs conducted in May 1967 are presented. Data on fallout monitoring of air, precipitation, milk, water, soil, and human bone are presented. Data on beta activity in air and precipitation are compared with similar data through 1966. The amounts of ^{137}Cs, ^{89}Sr, and ^{90}Sr in whole milk are tabulated. The ^{90}Sr in the 1966 crop of Canadian Hard Red Spring Wheat was measured and compared with that of the crops since 1957. The results of environmental monitoring near several Canadian reactors are given. The amount of alpha and beta activity in surface waters is given. The ^{137}Cs, ^{89}Sr, and ^{90}Sr concentrations in surface waters and in whole milk are tabulated. (L.C.L.)

39054 (NP-16993) RADIOACTIVITY SURVEY DATA IN JAPAN. Number 14. (National Inst. of Radiological Sciences, Chiba (Japan)). Feb. 1967. 25p. Dep.

Data on monthly and cumulative deposits of ^{137}Cs and ^{90}Sr are presented for six locations in Japan. Source water from twenty-one locations was analyzed for ^{137}Cs and ^{90}Sr. The content of ^{90}Sr and ^{137}Cs in rice and ^{90}Sr in wheat were determined and the ^{137}Cs content in the human body was observed. Gross β radioactivity in dust, rain and the upper air was measured. Highly radioactive particles in fallout were detected with a Geiger–Mueller end-window type survey meter and monitored by a γ-ray scintillation counter synchronized with a recorder. Radioactive fallout was radiochemically separated and concentrations of radioactive I in milk were determined. (F.S.)

39055 (PROT-SAN-02/66) DATA ON ENVIRONMENTAL RADIOACTIVITY COLLECTED IN ITALY (JANUARY–JUNE 1965). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). June 1966. 280p. Dep.

ITALY — environmental radiation monitoring in, Jan. through June 1965
RADIATION MONITORING — environmental, in Italy, Jan. through June 1965
RADIOACTIVITY — measurement of environmental, in Italy
FALLOUT — monitoring in Italy
ATMOSPHERE — radioactivity of Italian ground level
GROUND — fallout deposition on Italian
GROUND WATERS — radioactivity in Italian
FISH, PLANKTON — radioactivity in Italian sea and fresh water
SILTS — radioactivity in Italian sea
SEA WATER, SURFACE WATER, MILK — cesium-137 and strontium-90 content in Italian
CESIUM ISOTOPES Cs-137, STRONTIUM ISOTOPES Sr-90 — content in Italian air, foods, soil, and waters
MEATS — strontium-90 content in Italian
VEGETABLES — cesium-137 and strontium-90 content in Italian
REACTORS — radiation monitoring in vicinity of Italian
BETA PARTICLES — activity in Italian drinking, rain, and sea waters
RAINWATER — radioactivity in Italian (L.C.L.)

39056 (PROT-SAN-10/66) DATA ON ENVIRONMENTAL RADIOACTIVITY COLLECTED IN ITALY (JULY–DECEMBER 1965). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Oct. 1966. 238p. Dep.

ITALY — environmental radiation monitoring in July through Dec. 1965
RADIATION MONITORING — environmental, in Italy, July through Dec. 1965
RADIOACTIVITY — measurement of environmental, in Italy
FALLOUT — monitoring in Italy
ATMOSPHERE — radioactivity of Italian ground level
GROUND — fallout deposition on Italian
GROUND WATERS — radioactivity in Italian
FISH, PLANKTON — radioactivity in Italian sea and fresh water
SILTS — radioactivity in Italian sea
SEA WATER, SURFACE WATERS, MILK — cesium-137 and strontium-90 content in Italian
CESIUM ISOTOPES Cs-137, STRONTIUM ISOTOPES Sr-90 — content in Italian air, foods, soil, and waters
MEATS — strontium-90 content in Italian
VEGETABLES — cesium-137 and strontium-90 content in Italian
REACTORS — radiation monitoring in vicinity of Italian
BETA PARTICLES — activity in Italian drinking, rain, and sea water; activity in Italian rainwater
RAINWATER — radioactivity in Italian (L.C.L.)

39057 DECAY OF A DISTURBANCE IN THE NATURAL DISTRIBUTION OF ^{14}C. Plesset, Milton S. (California Inst. of Tech., Pasadena); Dugas, Doris J. J. Geophys. Res., 72: 4131-7 (Aug. 15, 1967).

The decay of an excess of carbon 14 deposited in the atmosphere as a consequence of a nuclear explosion is calculated. A cyclic model having four reservoirs for exchangeable carbon is developed to describe this decay of excess carbon 14. In the cyclic model the atmosphere is considered to have an interface with both the mixed ocean layer and the deep sea. The extent of mixing between the atmosphere and the deep sea is not accurately known; therefore, calculations were made for exchange ratios of $\eta = 1$, 3, and 10, where η is the ratio of the atmosphere-mixed-layer exchange rate to the atmosphere-deep-sea exchange rate. At $\eta = 10$, the decay pattern of the cyclic model approaches that of a chain model, that is, one in which no direct mixing between atmosphere and deep sea occurs. Over the range of exchange ratios from 1 to 3, the long-term decay of carbon 14 in the atmosphere changes markedly; therefore, it would be of considerable interest to obtain further data on the amount of mixing in the oceans. (auth)

39058 SHORT-RANGE DATING OF FRESH NUCLEAR DEBRIS. Sotobayashi, T.; Suzuki, T.; Koyama, S. (Niigata Univ., Japan). Nature (London). 215: 728-9(Aug. 12, 1967).

A study of debris particles detected in ground air and rain water at Niigata on May 11th, November 1st and December 30th, 1966, is described. The particles collected on May 11th undoubtedly resulted from a Chinese nuclear test conducted on May 9th. These particles, of known origin, provided a favorable opportunity to examine a rapid method for dating of nuclear debris particles shortly after their formation. Determination of the activity ratio of a short-lived to a relatively long-lived fission product in a debris particle at a given time after the fission process can be employed as a sensitive test of the age of the debris. The pairs $^{97}Zr/^{95}Zr$, $^{133}I/^{131}I$, and $^{143}Ce/^{141}Ce$ were considered the most useful for this purpose, and of these $^{97}Zr/^{95}Zr$ was chosen, because of similar fractionation behavior. Some highly fractionated larger particles (>10μ) consisted mainly of short-lived refractory fission products, such as ^{97}Zr, ^{99}Mo and ^{143}Ce, with no detectable amounts of $^{132}Te-^{132}I$ and ^{133}I, and in this case radiozirconium activities were directly measured with no chemical separation. Many of the particles contained considerable amounts of the short-lived volatile $^{132}Te-^{132}I$ and ^{133}I, and for these chemical separation was employed. Data obtained are tabulated and shown graphically. From the results it would seem possible that when nuclear explosions occur with a time interval of >10 h, debris from them can be distinguished by measuring the activity ratio of $^{97}Zr/^{95}Zr$ for up to a week after their formation. This method of age determination was tested on particles collected on Dec. 30th, 1966, and it was concluded that the explosion from which these particles originated was between 1200 and 1700 h (Japanese time) on December 28th. (UK)

39059 SURFACE AIR RADIOACTIVITY AND OZONE AT AMUNDSEN–SCOTT STATION (90°S), ANTARCTICA. Aldaz, L. (Univ. of N. Mex., Albuquerque). Nature (London), 215: 722-3 (Aug. 12, 1967).

The Amundsen–Scott Station in the Antarctica offers, by virtue of its extreme isolation from man-made pollution, a unique setting for the study of atmospheric radioactivity. Continuous measurements of surface air radioactivity levels at the South Pole from 1959 to 1963 have previously been reported, and additional data up to 1965 are presented in this communication. Surface ozone records for 1962 to 1965 are also given. Fission product and ozone data are presented graphically, and a yearly oscillation for both sets of data is observed, opposite in phase, and with a 6-month phase difference. It is possible that seasonal variations in atmospheric exchange between the middle latitudes of the northern hemisphere and the polar regions are somehow controlling the observed annual oscillation of radioactivity and ozone in the surface air at the South Pole. (UK)

39060 DETERMINATION OF FISSION PRODUCTS DEPOSITED ON THE GROUND. Bakacs-Polgar, E.; Kurcz-Csiky, I. (State Inst. of Hygiene, Budapest). Atompraxis, 13: 301-2 (July 1967).

The monthly average of total beta-activity and radioactive strontium deposited on the ground and on plants was determined partly by determining the air pollution, partly by investigating the total fallout. It was found that ^{90}Sr deposited on the ground was represented more reliably by fallout measurement than by investigation of the atmosphere rainfall. The total beta-activity due mainly to short-lived isotopes decreased considerably after the atomic truce agreement; the decrease in ^{90}Sr content in 1964 was less pronounced. The Chinese atomic bombs, exploded in October 1964 and in May 1965, caused fallout, although only to a slight extent. (auth)

39061 VARIATIONS OF THE GAMMA-RAY BACKGROUND DOSE RATES AND ATMOSPHERIC RADON CONCENTRATION IN WARSAW. Pensko, J. (Central Lab. for Radiological Protection, Warsaw). Atompraxis, 13: 310-12(July 1967).

Systematic observations of γ background were carried out in Warsaw. It was found that the terrestrial dose rate is greater in summer than in winter. Rain-showers bring a temporary increase in γ background radiation. The contribution to this radiation from derivations of radon contained in the atmosphere and from fission products was established. (tr-auth)

Mineralogy

39062 COFFINITE FROM CARBONATE VEINS. Soloviova, F. I. Dopov. Akad. Nauk Ukr. RSR, Ser. A, No. 5, 423-8(1967). (In Russian).

Coffinite, $USiO_4$, in a vein formation was found in carbonate veins. It forms fine veins or grows on the schist, quartzite, and pyrite fractions. Coffinite in a form of pillar- or needle-shaped crystals with tetragonal section grows on pyrite. Crystals with slightly rounded ends are observed apart from the sharp crystalline aggregates. The reflecting power and hardness of some places in coffinite correspond to those of uraninite. Microhardness H = 380 to 420 kg/mm², the reflecting power is ≈7 to 9%. The x-ray diffraction pattern of coffinite under investigation agrees well with the standard one. Relation of coffinite with carbonate vein minerals indicates to its formation during the last stages of the hydrothermal process. (auth)

Oceanography

Refer also to abstracts 39002, 39048, and 39168.

39063 (COO-689-76, App.A-IV) STRONTIUM ISOTOPIC ANALYSES OF THREE MARINE PHILLIPSITES FROM THE PACIFIC OCEAN. Pushkar, Paul; Peterson, M. N. A. (Arizona Univ., Tucson. Geochemical Section). 3p. (COO-689-81).

Results of measurements of $^{87}Sr/^{86}Sr$ ratios in samples of marine phillipsites from pelagic clays of the deep Pacific are presented. (J.R.D.)

39064 (RLO-1725-73) DISTRIBUTION AND MOVEMENT OF RADIOACTIVE CONTINENTAL SHELF SEDIMENT, NORTHWESTERN UNITED STATES. Gross, M. Grant (Washington Univ., Seattle. Dept. of Oceanography. National Museum, Washington, D. C.). Jan. 1967. Contract AT(45-1)-1725. 8p. (CONF-670803-2). Dep. CFSTI.

From 7th International Sedimentological Congress, Reading, England, and Edinburgh.

The results of studies made from 1961 to 1963 on the radioactivity and movement of sediments on the Continental Shelf near the Columbia River are reviewed. Sediments contained radioactivity from naturally occurring radionuclides, radioactive fallout from atmospheric testing of nuclear weapons, and radionuclides released from Hanford. Results of the studies do not indicate whether the entire sediment or only certain size fragments are moving. Data on the velocity of near bottom currents are not available but it appears that radioactive particles move at speeds of 0.08 to 0.16 cm/sec. (F.S.)

39065 (RLO-1750-22(Vol.2)) ECOLOGICAL STUDIES OF RADIOACTIVITY IN THE COLUMBIA RIVER ESTUARY AND ADJACENT PACIFIC OCEAN. Progress Report, July 1, 1966–June 30, 1967. Osterberg, Charles L. (Oregon State Univ., Corvallis. Dept. of Oceanography). Contract AT(45-1)-1750. 144p. Dep. CFSTI.

Separate abstracts have been prepared for the two papers comprising the volume. (F.S.)

For abstracts of individual papers see: 39002 and 39044.

Seismology

Refer to abstract 39070.

ENGINEERING

Nuclear Explosions

Refer also to abstracts 39003, 39045, 39057, 39155, and 39158–39160.

39066 (AD-633618) THEORETICAL GROUND SHOCK EFFECTS. VOLUME I. GROUND MOTION IN ELASTIC HALF-SPACES INDUCED BY AIR BLAST. Final Report. Gans, Roger F.; Brooks, John A. (United Aircraft Corporate Systems Center, El Segundo, Calif. Weapons Effect and Support Systems Dept.). Dec. 1965. Contract DA-49-146-XZ-220. 132p. (SCR-275-(Vol.1); DASA-1676-1). CFSTI.

Ground response to the air blast loading caused by a surface nuclear burst in the elastic region was treated using a ground model of elastic half space both layered and non-layered. The air blast loading was approximated by a source of acoustic waves in an overlying fluid. The emphasis is directed toward the investigation of surface wave effects. Discussion of the response in terms of velocities and stresses at various points in the media is included. The data are presented in graphical form and the necessary derivations are given. In addition the nature of the Rayleigh wave is discussed and a simple damping constant for the Rayleigh response is shown to exist naturally in the solutions. (auth) (TAB)

39067 (AD-637197) THEORETICAL GROUND SHOCK EFFECTS. VOLUME II. APPLICATION OF GENERALIZED COORDINATES TO PLASTIC WAVE PROBLEMS. Final Report, December 1965. Brooks, John A. (United Aircraft Corporate Systems Center, El Segundo, Calif. Weapons Effect and Support Systems Dept.). Aug. 1966. Contract DA-49-146-XZ-220. 59p. (SCR-294; DASA-1676-2). CFSTI.

Two generalized coordinate formulations of the equation of motion and two sets of constitutive relations for the elasto-plastic region surrounding a surface nuclear explosion are presented. The first generalized coordinate formulation is in terms of generalized displacements and has been programmed and tried. It is deficient because of the departure of the solution into the complex domain. The second formulation obviates this deficiency since the inertial terms are linear and the matrix of the highest order derivatives can always be made non-singular by proper choice of basis functions. The first set of constitutive equations is of the Coulomb-limiting shear type with many special cases. The second treatment is simpler as a result of the "rounded corners" of the yield surface expressed in terms of stress invariants. (auth) (TAB)

39068 (DASA-1859) BLAST-INDUCED TRANSLATIONAL EFFECTS. Technical Progress Report. Fletcher, E. Royce; Bowen, I. Gerald (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Nov. 1966. Contract DA-49-146-XZ-372. 38p. Dep. CFSTI.

A mathematical model was developed to predict the time displacement histories of objects translated by the blast winds from conventional or nuclear explosions; these predictions were compared with results of explosion experiments. The objects studied varied in size from 139-mg spheres to man and were all assumed to be free to move over a smooth horizontal surface. The effects of ground friction could either be included or neglected, but when they were considered the ground friction eventually brought the objects to rest after the winds had passed. The values of ground friction used were determined experimentally and were found to be functions of the velocity and mass of the object being displaced. The translational model was general enough for either classical or non-classical blast waves to be considered. Results for a chemical explosion were obtained by using both the computed blast waves determined in previous work and the experimentally determined blast waves. These predicted results were compared with each other as well as with experimental data obtained with steel spheres. The model was used to determine dynamic-pressure impluses necessary to explain the measured sphere velocities at three ranges from ground zero. Another mathematical model was briefly described which was developed to compute the detailed two-dimensional trajectories of objects as they roll, slide, and bounce along the ground. The model closely predicted the measured distances between bounces and the total displacements of concrete blocks and large stones and thus helped to explain the mechanisms of tumbling by which an irregular object may become airborne during both the accelerative and the decelerative phases of displacement. (auth)

39069 (PNE-510F) DESIGN, CONSTRUCTION, AND POST-SHOT EVALUATION OF CONCRETE STEM FOR ACCESS HOLE, Project PRE-SCHOONER II. Saucier, Kenneth L.; Stewart, F. S. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). May 1967. 33p. Dep. CFSTI.

Project Pre-Schooner II consisted of a 100-ton chemical explosive detonated in hard, dry rock at a depth of 71 feet. The primary purpose of the project was to increase the knowledge of crater dimensions in hard, dry rock as a function of depth of burst and type of explosive. This report describes the proportioning of a concrete mixture used in stemming the access hole of the shot cavity, the design of the stem configuration, laboratory tests conducted on core samples from the site and on specimens of the concrete mixture required for design of the stem, and placement of the concrete at the job site. Based on observations of the detonation, fractured pieces of the reinforced concrete stem, and the size of the crater, it is believed that the stem acted effectively to stem the detonation. (auth)

39070 (PNE-1105) INTERMEDIATE RANGE GROUND MOTIONS, Project PRE-GONDOLA I. Power, Dean V. (California Univ., Livermore. Lawrence Radiation Lab.). May 22, 1967. Contract W-7405-eng-48. 52p. Dep. CFSTI.

Ground motions were measured during the Pre-Gondola site calibration events and the Pre-Gondola I events on Fort Peck Dam and free-field locations out to 95 km. These events included yields of 0.5 and 20 tons of high explosive detonated at various depths. A variation of peak ground motion with depth of burial was noted which indicated that peak motions from a completely contained explosion may be 1.5 to 2 times the motion resulting from an explosion placed at optimum depth for a cratering experiment. Attenuation with radius was found to be proportional to $R^{-2.45}$ for this region with at least one anomalous "hot spot" at 95 km north of ground zero (GZ). Motions on the dam were comparable to free-field motions but vibrations persisted for longer times at the dam's natural frequency. Variation in motion was found to be proportional to the 1.0 power of the yield. Predictions for motions resulting from the Pre-Gondola II event are made. (auth)

39071 (PNE-1110) LIDAR OBSERVATIONS OF THE PRE-GONDOLA I CLOUDS. Final Report. Oblanas, John W.; Collis, Ronald T. H. (Stanford Research Inst., Menlo Park, Calif.). Jan. 1967. Contract AT(04-3)-115. 74p. Dep. CFSTI.

For Univ. of California Lawrence Radiation Lab., Livermore.

Lidar (laser radar) observations of the dust and steam clouds that resulted from the Pre-Gondola I series of four chemical explosions made near Fort Peck Reservoir, Montana, during October to November 1966 are described. The neodymium lidar was well able to track the clouds even when they became too tenuous to be seen visually or photographed. Observational data were analyzed to obtain cloud dimension, height, volume, rate of growth, volume backscatter coefficient and relative density variations. It is concluded that lidar tracking techniques can provide unique information on the position, motion, rate of growth, and internal structure of visible and sub-visible clouds resulting from large-scale explosions, and recommendations are made for improving the operational efficiency of the technique. (auth)

39072 (PNE-3005) GENERAL REPORT ON THE ECONOMICS OF THE PEACEFUL USES OF UNDERGROUND NUCLEAR EXPLOSIONS. Morgenstern, Oskar; Heiss, Klaus-Peter (Mathematica, Princeton, N. J.). Aug. 31, 1967. Contract AT(04-3)-691. 218p. Dep. CFSTI.

An evaluation of the economics of the Plowshare program is presented. The four major applications include the stimulation of gas and oil reserves, production of shale oil, mining, and cratering. An analysis is made of the costs of nuclear explosives such as implacement costs, cost of the devices, safety, and an estimate of the potential benefits to the economy. Other uses of nuclear excavations, such as the development of underground storage reservoirs for fuels, water, and wastes, are considered. It is concluded that there exists substantial economic benefits in each of the four principal fields of peaceful uses of nuclear explosives. (L.C.L.)

39073 (PNE-5009) ENGINEERING PROPERTIES OF NUCLEAR CRATERS. REPORT 4. THE FORMATION AND INITIAL STABILITY OF SLOPES ON COHESIONLESS MATERIALS. Technical Report No. 3-699. MacIver, Bruce N. (Army Engineer Waterways Experiment Station, Vicksburg, Miss). Aug. 1967. 113p. Dep. CFSTI.

The engineering properties of nuclear craters were studied to identify and describe the physical properties that will control the use of a nuclear crater for engineering purposes. One of the prime considerations in the engineering use of a nuclear crater is the

stability of the crater slopes. The inclination of a slope formed by deposition of cohesionless material is termed the angle of deposition. The angle of repose is defined as the maximum possible inclination of a slope of cohesionless material. Such factors as particle size, shape, and angularity, structure of particle aggregations, manner of deposition, and geometry of slopes are discussed with regard to their relative influence on each of the aforementioned angles. A few simple analytical relations are given to aid in understanding the behavior of particles during deposition and their stability on an inclined surface. Empirical data from laboratory tests, stockpiles, rock-fill dams, natural slopes, explosion-produced craters, etc., are presented and compared. It is concluded that angles of deposition for cohesionless rock and soil materials vary between 22 and 42 deg, and generally lie between 34 and 37 deg for angular particles, whereas angles of repose range between 27 and 47 deg, and generally lie between 37 and 47 deg for angular particles. The initial factor of safety of a slope formed by deposition will probably exceed 1.1 but will be nore more than 1.5 in most cases. (auth)

39074 (AEC-tr-6858) SELECTED ARTICLES FROM THE COLLECTION OF INVESTIGATION REPORTS ON ATOMIC BOMB DISASTER, VOLUME 1, 1953. Translated from pp 467-77; 483-91 of Collection of Investigation Reports on Atomic Bomb Disaster, Volume 1, Japan Science Promotion Society, 1953. 18p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

Separate abstracts have been prepared for three articles selected from a collection of investigation reports on atomic bomb disasters in Hiroshima and Nagasaki. (F.S.)

For abstracts of individual papers see: 39158–39160.

Facilities and Equipment

Refer also to abstracts 39142, 39172, 39959, 40730, and 40746–40748.

39075 (NASA-SP-9000) NASA SPECIFICATIONS AND STANDARDS. (National Aeronautics and Space Administration, Washington, D. C. Scientific and Technical Information Div.). May 1967. 380p. CFSTI.

Equipment specifications and standards originated by NASA through December 1966 are assembled and presented in one publication. The specifications are arranged in sections: Section I lists the specifications and standards by the alpha-numeric designation assigned by the originating organizations. Section II is an alphabetical listing of subject headings. Section III groups the specifications and standards by NASA Center of origin. (L.C.L.)

39076 (NP-16770) SIMULATOR DER RADIOAKTIVITAET. (Simulator of Radioactivity). ABC Bulletin No. 3. Pretre, S. (European Organization for Nuclear Research, Geneva (Switzerland)). Sept. 1963. 21p. (In German). Dep.

A radioactivity simulator designed for training purposes is described. An ultra shortwave radio emitter with a directional antenna, which permits the simulation of the wind, is installed at ground zero. The emitter emits pulses which are received by a device measuring the number of pulses and not the intensity of the electromagnetic field. The techniques for simulation of fallout of radioactive dust, the decrease of the activity with time, decrease of intensity with distance, and superposition of the simulation processes are outlined. The advantages of this type simulator are considered. (J.S.R.)

39077 (ORNL-P-3229) PROBLEMS AND SUCCESSES IN THE FIRST MAJOR MAINTENANCE PERFORMED IN THE TRANSURANIUM PROCESSING PLANT. Matherne, J. L.; Collins, E. D.; Evans, W. W. (Oak Ridge National Lab., Tenn.). [1966]. Contract W-7405-eng-26. 12p. (CONF-671102-10). Dep. CFSTI.

For Presentation at 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

Major maintenance that was performed after seven months of operation demonstrated that we could successfully handle all the maintenance problems and techniques that are expected to be encountered in the foreseeable future in the Transuranium Processing Plant. The equipment racks in one processing cubicle were removed and modified, and extensive revisions and replacements were made in the corresponding tank pit. The maintenance was accomplished without significant mechanical, radiation, or contamination problems, and the facility was returned to full-scale operation. (auth)

39078 (ORNL-TM-1841) EQUIPMENT COMPONENTS FOR LARGE EVAPORATOR PLANTS: A SUMMARY REPORT. Spiewak, I.; Mitchell, B. E. (Oak Ridge National Lab., Tenn.). Sept. 1967. Contract W-7405-eng-26. 117p. Dep. CFSTI.

Investigations were undertaken to determine whether the equipment components needed for 50 million gallons per day (Mgd) and larger seawater distillation plants were available from industry. Included in the investigations were condenser tube bundles, condenser tubing, tubing fabrication methods, interstage tube seals, demisters, deaerators, deaerator jets and blowers, valves, and vapor compressors. It was concluded that suitable equipment for desalting plant applications was generally available without extensive development by the Office of Saline Water (OSW) with the following exceptions: More information is needed on the service life of materials useful in evaporator components. This can be gained from test bed plants, pilot plants, and loops and does not require full-scale equipment. An applied materials program should reduce the cost and/or increase the reliability of all evaporator components. Although adequate condenser tubing is available now, approaches for reducing the cost and/or increasing the reliability of tubing include welded tubes of conventional alloys, the associated welded tubes of titanium, very long tubes, and methods of quality control. The technology of deaerator design is not sufficiently advanced to guarantee the low levels of oxygen and carbon dioxide desired to minimize corrosion. More knowledge of flash-chamber and condenser behavior could eliminate unnecessary design safety factors. Savings might be gained in the elimination of demisters in some stages of multistage flash evaporators and in the reduction of "fouling" factors in condenser design. The OSW has initiated active development programs in most of the areas indicated above. (auth)

39079 (TID-24014) X-344 FEED MATERIALS FACILITY: MECHANICAL AND ELECTRICAL CONSTRUCTION SPECIFICATIONS. (Giffels and Vallet, Inc., Detroit, Mich.). [1956]. 450p. Dep. CFSTI.

Specifications are presented for a feed materials facility in two volumes in a single binder. Volume one is concerned with specifications associated with architectural and structural trades. Volume two is concerned with specifications associated with mechanical and electrical trades. (J.R.D.)

39080 (TID-24015) X-344 FEED MATERIALS FACILITY: MECHANICAL AND ELECTRICAL BILL OF MATERIALS. (Giffels and Vallet, Inc., Detroit, Mich.). [1956]. 375p. Dep. CFSTI.

Bills of materials are presented for a feed materials facility, grouped under mechanical and electrical components and assemblies. Fifty specifications are included in the mechanical group and thirty-two in the electrical group. (J.R.D.)

39081 (UCRL-13304) DESIGN AND DEVELOPMENT OF ROSSI OSCILLATORS AND MIXERS. Monthly Progress Report No. 12 and Final Report Summary, June 1967. (Montana State Univ., Bozeman. Electronics Research Lab.). Contracts W-7405-eng-48; 8-0009-906. 10p. Dep. CFSTI.

For California Univ., Livermore. Lawrence Radiation Lab.

Transistorized Rossi oscillators were developed to operate at fixed specified frequencies with less than 2% distortion over an output range of 2 to 22 W at a 50 Ω load level. Suitable ground quartz crystals oriented for an AT-cut were used. The crystals do not require a temperature controlled oven to maintain the required frequency accuracy. At 2, 5, and 10 MHz, the crystals operate in the fundamental mode. At 20, 40 to 50, 80 to 100, and 200 MHz, the crystals operate in a series mode, 3rd overtone. Improved Rossi mixers were also developed with one unit covering frequencies of 2, 5, 10, 20, 40, 80, 100, and 200 MHz, and a second unit covering 333.333, 400, and 500 MHz. Each unit contains an attenuator to provide control of the Rossi signal level, suitable traps to block the sweep signal from the Rossi signal line, traps to block the Rossi signal from the sump generator circuits and a tuned circuit to provide impedance transformation. (F.S.)

39082 (JPRS-41816) PNEUMATIC INSULATION SUIT FOR RADIOACTIVITY PROTECTION. Gorodinskii, S. M.; Shcherbakov, V. L. Translated from Gig. Sanit., 32: No. 5, 43-6(1967). 5p. (TT-67-32448). CFSTI.

An insulation suit with its own system for regenerating a breathing mixture is described. The suit can be used in environments contaminated with radioactivity. It is effective in providing 99.9% protection from gases and aerosols, is easily decontaminated, and has minimum dimensions making it useful for operations in limited space. The equipment may be used for up to two hr in temperatures of 40 to 45°C. Equipment consists of the insulation suit, air regenerating system, and a cooling suit which is worn over the insulation suit. (F.S.)

39083 (K-Trans-24) ULTRACENTRIFUGE WITH MAGNETICALLY SUSPENDED ROTOR DRIVEN BY A MAGNETIC ROTATING FIELD. Translated for Union Carbide Corp., Nuclear Div., Oak Ridge, Tenn., from German Patent 1,187,400. 10p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

An ultracentrifuge with a magnetically suspended rotor which is

driven by a magnetic rotating field is described. The rotor without a solid shaft has an annular jacket consisting of ferromagnetic material which encloses a central cylindrical cuvette space. The top and bottom of the space consists of a transparent material. A camera for closed-circuit television may be installed above the cuvette. A hollow cylinder consisting of a ferromagnetic material with a dia slightly larger than the dia of the rotor is freely suspended on wires slightly below the rotor in an annulus filled with a damping fluid. (F.S.)

39084 (ORNL-tr-1727) TEMPERATURE CONTROL IN LIQUID METALS BY A RADIOMETRIC METHOD. Kutovoi, V. I.; Stetsenko, V. I. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.), from Izmer. Tekh., No. 8, 17-20(1965). 7p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

A radioisotopic method is described for continuous contactless control of liquid metal temperatures by measuring the metal's absorption of gamma radiation. The method is a reliable technique for control of liquid metal temperature and density. (J.R.D.)

39085 PUERTO RICO NUCLEAR CENTER: ITS PRINCIPAL IRRADIATION FACILITIES AND SCIENTIFIC PROGRAM. Rushford, F. E. (Puerto Rico Nuclear Center, Rio Piedras). Isotop. Radiat. Technol., 4: 251-5(Spring 1967).

The Puerto Rico Nuclear Center is well equipped with irradiation facilities to conduct a diversified program of research and training in the peaceful applications of nuclear energy. Research is directed chiefly toward problems of national and international interest which are best approached in the tropical environment such as that of Puerto Rico. (auth)

39086 ENERGY SOURCE OF A MAGNETICALLY DRIVEN SHOCK TUBE. Chang, C. T. (Danish Atomic Energy Commission, Riso, Denmark). 10p. (CONF-661041-4). DTIE.

From 1st European Conference on Controlled Fusion and Plasma Physics, Munich.

In order to study the effect of the variable load due to the motion of the current sheet on the driving current of a magnetically driven shock tube, it was demonstrated that the usual snow plow model is adequate for the purpose. On the basis of this model, it was shown theoretically that a shock moving at a constant speed can be obtained by using a constant voltage source. Analytical solutions for the time history of the current and the position of the current sheet are obtained for two cases; namely when the characteristic impedance of the voltage source is negligible and when it is dominating. The steady state current I, the voltage of the source V_0 and the initial gas pressure p_1 are related as $I \sim V_0^{\frac{1}{2}} p_1^{\frac{1}{4}}$ in the former case and as $I \sim V_0$ in the latter case. The steady state speed of the current sheet u varies as $I/p_1^{\frac{1}{2}}$, does not depend on the characteristic impedance of the voltage source explicitly. (auth)

39087 GAS-LIQUID SEPARATION ON A VANE OF A RADIAL VANE SEPARATOR. Kudirka, A. A.; Robbins, C. H.; Moen, R. H. (General Electric Co., San Jose, Calif.). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-11, 9p., $1.50. (CONF-661102-20). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

Experimental and analytical studies of separation of gas-liquid mixtures flowing on the concave surface of a vane of a radial vane separator were performed as part of the development program of an internal steam separator for a reactor. Separation of air-water mixtures on the vane was very effective for a wide range of experimental conditions for the selected design, agreeing in essence with the results of separation analysis. Extrapolation of these results to steam-water conditions at 1000 psi indicated that separation of these vanes should be complete enough to satisfy design requirements for typical boiling water reactors. (auth)

39088 BEAM SWITCHYARD COLLIMATOR (Engineering Materials). (Stanford Linear Accelerator Center, Calif.). (CAPE-1635).

18 drawings.

A collimator and collimator positioner or drive system for the Stanford Linear Accelerator are described. Collimators are used in isolating a portion of an electron beam cross section when the energy of the particular part of the cross section is required for an experiment. The collimator is part of the beam switchyard. For other equipment in the beam switchyards see CAPES-1483 and 1514. (For details see TID-4100 Suppl. 41). (F.S.)

39089 CONNECTING DEVICES. Raven, Anthony David (to The English Electric Co.). British Patent 1,076,982. July 26, 1967. Filed Jan. 30, 1964.

A connecting device to be mounted on a drum-held winding inside a reactor servicing machine is described. The equipment in which the connector is used is designed to raise and lower a television camera in reactors. (J.R.D.)

39090 IRRADIATION PLANTS. (to Sulzer Brothers Ltd.). British Patent 1,078,963. Aug. 9, 1967. Priority date Apr. 13, 1964, Switzerland.

An irradiation facility is described which is comprised of a thick-walled chamber for a radiation source and a means of transferring material for irradiation between the chamber and the outside. (J.R.D.)

39091 IMPROVEMENTS RELATING TO DETECTORS FOR USE IN DETECTING THE PRESENCE OF GASES AND/OR VAPORS. Lovelock, James Ephraim British Patent 1,080,691. Aug. 23, 1967. Filed Feb. 14, 1963.

A chromatographic gas detector is described. The detector is equipped with a chamber containing an anode and a cathode connected to a source of potential and a current measuring device. The gas sample in the chamber is subjected to ionizing radiation. The ion pairs produced are proportional to the current flow through the chamber. (J.R.D.)

39092 LIGHT INTENSIFIERS FOR RADIATIONS. (to Matsushita Electric Industrial Co., Ltd.). British Patent 1,080,641. Aug 23, 1967. Priority date Aug. 2, 1963, Japan.

An invention relating to intensifiers for use with x ray and gamma sources is described. The intensifiers are improved by mechanical forming so that the radiation energy is more efficiently utilized without the sensitivity of the photoconductive element being lowered. (J.R.D.)

39093 IMPROVEMENTS IN HOT IMPACT EXTRUSION TECHNIQUES. (to Atomic Energy of Canada Ltd.). British Patent 1,080,456. Aug. 23, 1967. Priority date Mar. 17, 1965, Canada.

A blank for use in hot extrusion processes is described. The blank is comprised of an axially elongated Cu-coated annular pellet of ductile metal. A metal collar is secured coaxially at the end of the pellet, and an inner Cu sheath is included. One application of the extrusion process is exemplified by formation of a Zircaloy tube. (J.R.D.)

39094 AN IMPROVED METHOD FOR THE MANUFACTURE OF A NEUTRON SCREEN. Bosse, Johann-Friedrich; Bosse, Hans-Werner British Patent 1,080,406. Aug. 23, 1967. Priority date Aug. 18, 1964, Germany.

Fabrication of ligneous neutron shields is described. The material can be laminated and molded and water soluble boron compounds can be added. (J.R.D.)

39095 SHIELDED ENCLOSURE WITH ROTARY MANIPULATOR. Lemer, Jacques (to Establissements Lemer et Cie). British Patent 1,075,965. July 19, 1967. Priority date Oct. 1, 1963, France.

A method is described for construction of a hot cell enclosure which provides for full visibility of the interior and in which handling operations are made possible at all points, even when employing a single manipulator. (J.R.D.)

39096 NEUTRON GENERATOR. (to Gesellschaft fuer Kernforschung mbH). British Patent 1,080,545. Aug. 23, 1967. Priority date Nov. 27, 1963, Germany.

Design of a failsafe neutron generator of small dimensions having a high neutron intensity is described. Provision is made for maximum use of the neutron output by optimum target accessibility. (J.R.D.)

39097 WORKING EQUIPMENT COMPRISING A WORKING SURFACE FOR USE IN HANDLING RADIOACTIVE MATERIALS. (to Brown Boveri/Krupp Reaktorbau GmbH). British Patent 1,080,049. Aug. 23, 1967. Priority date Sept. 5, 1964, Germany.

Laboratory equipment comprising a working surface for radioactive material handling is described. The working surface, enclosed in a vented hood, is covered by epoxy-resin-based plastics that can be applied in a liquid state. (J.R.D.)

39098 MEANS FOR PURIFYING WATER. (to Allmanna Svenska Elektriska Aktiebolaget). British Patent 1,075,186. July 12, 1967. Priority date Oct. 10, 1963, Sweden.

A means of purifying boiler feed water or reactor primary coolant using beds of iron or steel pellets is described. The pellets are coated with surface layers of magnetite or mixed oxides having a spinel structure. (J.R.D.)

39099 PERFORATED PLATES, AND TANK FITTED THEREWITH. Guillot, Claude; Peuchmaur, Alphonse (to Commissariat a l'Energie Atomique). British Patent 1,079,278. Aug 16, 1967. Priority date June 24, 1964, France.

A description is presented of a perforated plate constructed of I-section structural girders welded together side by side along the largest plate dimension forming between each pair of adjacent structural girders a longitudinal passage open at both ends. The webs of the girders are pierced from the face of the plate to the

other by uniformly spaced bores which are isolated from the longitudinal passages. (J.R.D.)

39100 IMPROVEMENTS IN OR RELATING TO MEANS FOR DISCHARGING GRANULAR OR PULVERULENT MATERIAL FROM A CONTAINER. Baines, Bernard Deryck; Lockington, Derek Charles (to Nuclear Chemical Plant Ltd.). British Patent 1,072,265. June 14, 1967. Filed Sept. 4, 1964.

Equipment is described for use in irradiation of granular or pulverulent materials in a manner that ensures uniform treatment throughout the material prior to its discharge. Shielding and discharge rate controls are provided. (J.R.D.)

39101 IMPROVEMENTS RELATING TO HEAT EXCHANGERS. Frame, Alexander Gilchrist; Taylor, Derek (to United Kingdom Atomic Energy Authority). British Patent 1,078,494. Aug. 9, 1967. Filed Mar. 25, 1963.

A heat exchanger is described for vaporizing a liquid, such as water, by heat transfer from a heat exchange medium such as Na or other liquid metal. The exchanger has different fluid heating sections such as evaporating, superheating, and reheating. The heat exchanger is subdivided into a large number of individual units. Each unit is in the form of a sheath duct containing tubing for the fluid to be heated. Ducts are connected in parallel to permit removal for replacement or repair of one without interfering with the remainder. Lapped-back configuration of the ducts facilitates tube mounting and minimizes tube length corrosion stressing. The run of the interior tubes in the general direction of the duct minimizes tube bending. (F.S.)

39102 IMPROVEMENTS RELATING TO STEAM TURBINES. Brazier, Peter Harding; Sidebotham, Arnold (to Associated Electrical Industries, Ltd.). British Patent 1,073,793. June 28, 1967. Filed June 13, 1963.

A steam turbine in which provision is made for removing moisture at an intermediate position in the steam path is described. An annular separator chamber at an intermediate stage has an axial length not less than three quarters of the radial width with fixed guide vanes at the inlet to produce a swirl of the steam in the chamber. A second annular chamber surrounds the separator chamber. Moisture laden steam and water are forced by the swirl action in the separator chamber and fixed guide vanes so that there are heat drops in the guide vanes at the inlet and outlet. Running at normal speed the swirl velocity is not less than 250 A/sec. (F.S.)

39103 IMPROVEMENTS IN TURBINES, COMPRESSORS AND PUMPS. (to Sulzer Brothers Ltd.). British Patent 1,074,923. July 5, 1967. Priority date Feb. 14, 1964, Switzerland.

A turbine compressor is described that comprises a shaft-mounted rotor and an axially sliding shaft seal contained in a main housing. The housing containing the shaft seal can be shut off from the circulating medium so that the seal can be removed or inspected. (J.R.D.)

39104 IMPROVEMENTS IN ROTARY TURBINES, COMPRESSORS AND PUMPS. (to Sulzer Brothers Ltd.). British Patent 1,074,940. July 5, 1967. Priority date Feb. 12, 1964, Switzerland.

Rotary turbines, pumps, and compressors are described which have a rotary bearing system which is mounted for axial movement in a housing from a working position to a sealing position. The housing has a seal against which the rotor bears when the system is axially moved to the sealing position. The seal allows two sealing zones separated by a space which may be connected to a higher- or lower-pressure source. (F.S.)

39105 DEVICE FOR USE IN ASSEMBLING A NUCLEAR FUEL CARTRIDGE. Le Coz, Francois; Mombazet, Rene; Raynaud, Noel (to Commissariat a l'Energie Atomique). British Patent 1,079,007. Aug. 9, 1967. Priority date Mar. 30, 1965, France.

A device is described which is used in assembling a nuclear fuel cartridge. The device consists of a support within an annular sleeve on which the base of the fuel element rests. Three members are uniformly spaced around the axis of the fuel element each of which engages a recess in the internal surface of the sleeve and a recess formed in the support. These members are held in position under the action of the weight of the support and the fuel element. The device is used in the simple and automatic assembly of the support and members inside the sleeve without direct manipulation which facilitates production line fabrication. (F.S.)

39106 IMPROVEMENTS RELATING TO FURNACES FOR MANUFACTURING INGOTS, PARTICULARLY OF URANIUM CARBIDE. (to Commissariat a l'Energie Atomique). British Patent 1,079,919. Aug. 16, 1967. Priority date Dec. 9, 1963, France.

A furnace is described which is used for the production of metal ingots or bars from metallic materials such as uranium carbide. The furnace consists of a vacuum enclosure containing a bottomless crucible with a double wall. A means for circulating a coolant fluid between the walls of the crucible, a system for feeding the material to be melted, and a control system for the vacuum are provided. (F.S.)

39107 IMPROVEMENTS IN MEASURING APPARATUS. Wadham, Geoffrey; Thurlbeck, Arther; Tinkler, Almond (to United Kingdom Atomic Energy Authority). British Patent 1,079,499. Aug. 16, 1967. Filed Dec. 18, 1964.

An apparatus is described for the accurate measurement of the diameter of vertical or near vertical channels such as reactor fuel channels. In operation a block is driven axially against the inner ends of probe arms to displace them radially to contact the channel walls. The amount of axial displacement of the wedge is proportional to the chamber diameter. A transducer measures the axial displacement. (F.S.)

39108 CRT CONTROL MARK II (Engineering Materials). (California. Univ., Livermore. Radiation Lab.). (CAPE-1632). 13 drawings.

The CRT Control Mark II "Mouse," a hand-manipulated input device for following and recording positions on a cathode-ray tube, is described. The graphical input device was designed for the PDP-1 Computer but can be adapted to any computer. (For details see TID-4100 Suppl. 41) (F.S.)

39109 HEAT EXCHANGER UTILIZING VORTEX FLOW. McGurty, James A.; Necker, William C. (to U. S. Atomic Energy Commission). U. S. Patent 3,339,631. Sept. 5, 1967.

A steam generating tube is described which is provided with a core comprising a tapered shank and a helical rib encircling the shank to define a spiralling flow path for steam generated within the tube. The generated steam travels at high velocities along the spiralling flow path and in doing so drives the unevaporated water against the inside wall of the tube in vortex flow. A significant increase in the burnout heat flux of the tube occurs as a result of the vortex flow of unevaporated water. (AEC)

39110 IRRADIATION DEVICE. Adany, Leon; Reynes, Georges (to Commissariat a l'Energy Atomique). British Patent 1,082,606. Sept. 6, 1967. Priority date Feb. 17, 1964, France.

An irradiation device is described which consists of an irradiation chamber located in a circuit containing the fluid to be irradiated and a radiation source located outside the chamber across from a window through which radiation can pass without being absorbed. The irradiation chamber is a cylindrical tube whose window has the same radius of curvature as the cylindrical tube. Blades are provided for scraping and agitation in the irradiation chamber. A refrigerant fluid is provided to cool the fluid flowing through the irradiation chamber. The refrigerant fluid is contained in a chamber which is defined by the irradiation chamber tube and a jacket which is eccentric with respect to the tube and is on the opposite side of the tube from the window. (F.S.)

39111 GRAPPLING SYSTEM. Brynsvold, G. V. (to U. S. Atomic Energy Commission). U. S. Patent 3,337,257. Aug. 22, 1967.

A grappling system for a fuel rod and having concentric cylindriform rotating cams driving a cam follower connected to concentric sleeves is described. A ball coupling is located between the sleeves and is forced into position by the sleeves, engaging a knob on top of the fuel rod which is adapted to lift the fuel rod out of the core. (AEC)

39112 ION GENERATOR HAVING BEAM STABILIZATION ACCELERATING ELECTRODES. Kelley, George G. (to U. S. Atomic Energy Commission). U. S. Patent 3,340,425. Sept. 5, 1967.

An improved ion generator is described which has an inverted cup-shaped accelerating electrode positioned from a flat plate encompassing an anode plasma expansion cup of the ion generator such that in the ion accelerating region there is no point of maximum potential along a magnetic field line. Electron oscillation cannot occur and thus the electrons are drawn out of the region as they are formed to permit operation of the ion generator at higher accelerating voltages and higher magnetic fields while providing an ion beam that is well focused, of good quality, and with an increased output. (AEC)

Heat Transfer and Fluid Flow

Refer also to abstracts 39101, 39109, 39130, 39131, 39553, and 40529.

39113 (ORNL-4057) A CLOSED-CYCLE PROCESS FOR PREVENTING SCALE FORMATION IN EVAPORATORS AND

PRODUCING INDUSTRIAL CHEMICALS AT A NUCLEAR DESALINATION PLANT. Blanco, R. E.; Yee, W. C.; Clark, W. E.; Holmes, J. M.; Salmon, R. (Oak Ridge National Lab., Tenn.). Sept. 1967. Contract W-7405-eng-26. 48p. Dep. CFSTI.

A closed-cycle process is proposed for removing scale-forming elements from seawater (descaling) in which all chemicals required for descaling are produced at the plant site, either directly from seawater or from recycle streams, using power from the nuclear reactors. In the principal flowsheet, caustic and sodium carbonate are added to seawater to precipitate greater than 95% of the calcium as calcium carbonate at pH 9.2. After removal of the precipitate, the pH is decreased to 7 by adding hydrochloric acid to permit evaporation (to a 4X concentration) at 350 to 400°F without scale formation. Caustic, chlorine, and hydrogen are produced from concentrated seawater in a conventional industrial electrolytic cell. The calcium carbonate is calcined to produce carbon dioxide, which is combined with caustic in a recycle stream to produce sodium carbonate for further descaling. Hydrochloric acid for pH adjustment is produced by the combination of 6% of the hydrogen and chlorine. An optional feature is the production of fertilizer either by combining electrolytic hydrogen and nitrogen from air liquefaction to produce ammonia or by combining this ammonia with excess carbon dioxide from calcined calcium carbonate to produce urea. Chlorine production (3440 tons/day) is about 75% of that of another plant in the U.S. and represents about 17% of the total chlorine produced in the U.S. in 1966. In alternative flowsheets, the calcium and magnesium are completely precipitated at pH 10 to 12, and the slurry is passed through the evaporator at the same pH; or the precipitate is removed, and the pH of the water is adjusted to any desired level prior to evaporation. Other variations show the recovery of magnesium, iodine, bromine, and lime. (J.R.D.)

39114 (TID-23986) NATURAL CONVECTION FLOWS IN PARALLEL CONNECTED VERTICAL CHANNELS WITH BOILING. Report No. 70318-49. Eselgroth, Peter W.; Griffith, Peter (Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering). July 1967. Contract AT(30-1)-3496. 61p. Dep. CFSTI.

The steady-state flow configuration in an array of parallel heated channels was examined for prediction of the behavior of a reactor during a loss of flow accident. A method of combining the results of single tube experiments with a calculation scheme for the multiple tube array is developed. Only single-single tube experiments were run. Three possible flow solutions for a channel are: gas and liquid flowing up, gas flowing up and liquid down, and both gas and liquid flowing down. This investigation eliminates the latter as a possible solution for a channel operating in an array of channels. For the two remaining flow cases the constraints of a common pressure drop across the channels and the satisfaction of continuity in the closed end plenum, determine a solution for each heat flux distribution over the array. Data in this investigation were obtained using Freon 113 as the coolant for an electrically heated glass tube. Data are not intended for use other than for verification of the method of solution proposed. It is recommended that the coolant intended for use in the application be used with a prototype, rather than a model, channel in obtaining the single channel data. (auth)

39115 (AD-651090) JOURNAL OF ENGINEERING PHYSICS (SELECTED ARTICLES). Translated from Inzh.-Fiz. Zh., 7: No. 9, 25-9; 38-43; 64-70; 71-7; 83-7; 88-91; 102-7(1964). 62p. (FTD-MT-65-329). CFSTI.

Seven papers on heat transfer and fluid flow are presented. A separate abstract was prepared for one article. The remaining six papers contain information on various aspects of heat transfer and fluid flow of gases and liquids. (L.C.L.)

For an abstract of the individual paper see: 39116.

39116 (AD-651090, pp 53-62) CONCERNING THE USE OF TWO-PHASE SYSTEMS AS A THERMODYNAMIC WORKING MEDIUM. El'perin, I. T.; Minkov, V. A. Translated from Inzh.-Fiz. Zh., 7: No. 9, 102-7(1964).

A thermodynamic analysis of thermoelectric power plant cycles using two-phase working substances (gas-solid suspensions) was conducted. It is shown that application of such working media promotes increased efficiency and specific work of the cycles. (auth)

39117 (NP-tr-1522) EXPERIMENTAL INVESTIGATION OF DETERIORATION CONDITIONS OF HEAT TRANSFER IN FLOW OF STEAM AND WATER MIXTURE IN HEATED PIPES. Kon'kov, A. S. Translated by A. Crozy (Atomic Energy Research Establishment, Harwell, Eng.), from Tr. Tsent. Nauch.-Issled. Proekt.-Konstr. Kotloturbinnogo Inst., 58: 170-8(1965). 18p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The deterioration conditions of heat transfer in the flow of steam and water mixtures in heated pipes were investigated. The steam contents and maximum internal surface wall temperatures were determined experimentally. The investigation showed that the point at which heat exchange for various steam contents begins to deteriorate depends on the pressure, mass velocity, specific heat flux, and diameter of the pipe. A criterial equation for calculating the steam content at the point of heat transfer deterioration over a range of parameters is given. (L.C.L.)

39118 EFFECT OF OXIDES ON HEAT TRANSFER DURING TRANSVERSE FLOW OF SODIUM METAL ACROSS STAGGERED TUBE BANK. Borishanskii, V. M.; Zhinkina, V. B.; Firsova, E. V. At. Energ. (USSR), 22: 317-18(Apr. 1967). (In Russian).

Heat transfer was measured on stainless steel tubes having a dia of 28 mm with relative spacings of $s_1/d = 1.25$ and $s_2/d = 1.07$. The range of the basic parameters was as follows: W = 0.09 to 1.0 m/sec; t_{liq} = 300°C; Re = 5000 to 67,000; Pe = 30 to 400; oxygen content in the sodium metal = 4×10^{-2}, 2×10^{-2} and 0.4×10^{-2} wt %. The average of the inlet and outlet temperatures was used in determining physical constants such as viscosity, density, etc. The experimental data were fitted in the following form: Nu = f(Pe). The oxygen content in the sodium metal had no effect on the heat transfer. The data could be fitted by one formula with an accuracy of ±30% : $Nu = (Pe)^{0.5}$. (TTT)

39119 HEAT TRANSFER DURING LONGITUDINAL-FLOW OF LIQUID METAL IN TRIANGULAR TUBE BANKS. Borishanskii, V. M.; Gotovskii, M. A.; Firsova, E. V. At. Energ. (USSR), 22: 318-20(Apr. 1967). (In Russian).

The heat transfer during longitudinal flow of a liquid metal in tube banks having relative spacings s/d = 1.1, 1.2, and 1.5 was calculated over a region of Peclet numbers Pe = 70 to 7000 and plotted in the form: Nu = f(Pe). The calculated values were compared with experimental data in tube banks having the same geometry at Prandtl numbers Pr equal to 0.007 and 0.03. The absolute values of the experimental heat transfer coefficients agreed well with the calculated values but were somewhat smaller than the calculated values. The best agreement was obtained for the tube bundle with s/d = 1.5, and the largest deviation was noted for the tube bundle with s/d = 1.1. (TTT)

39120 HEAT TRANSFER TO FULLY DEVELOPED LIQUID METAL FLOW IN TUBES. Emery, A. F.; Bailey, D. A. (Univ. of Washington, Seattle). J. Heat Transfer, 89: 272-3(Aug. 1967).

Heat transfer coefficients for fully developed liquid metal flow in tubes with constant wall heat fluxes are given for laminar and transitional flow. These experimental values agree with the Graetz value of 4.36, and support the work of Petukhov and Yushin in contradiction to that of Johnson, Hartnett, and Clabaugh. (auth)

39121 OPERATING CHARACTERISTICS OF CAPILLARITY-LIMITED HEAT PIPES. Cosgrove, J. H.; Ferrell, J. K.; Carnesale, A. (North Carolina State Univ., Raleigh). J. Nucl. Energy, 21: 547-58(July 1967).

Applications are suggested for the heat pipe, a device for the convective transfer of heat using an evaporation–condensation cycle, to nuclear direct conversion space power systems. An analytical model of the heat pipe is presented, consisting of basic mass, energy, and momentum balances, and is solved for the maximum heat transfer rate. Experiments yielding data suitable for testing the model are described, and the close agreement between analysis and experiment is demonstrated and discussed. (UK)

39122 BOILING HEAT-TRANSFER DATA AT LOW HEAT FLUX. Elrod, W. C. (Clemson Univ., S. C.); Clark, J. A.; Lady, E. R.; Merte, H. J. Heat Transfer, 89: 235-43(Aug. 1967).

Data are presented for natural and forced convection heat transfer from the outside of a single ¼-in.-dia tube to saturated water at 535 to 1550 psia. Nonboiling and nucleate boiling at low heat flux are considered for vertical and horizontal tubes. Water chemistry control is shown to be important in obtaining reproducible data. A new factor, suspended solid material in the boiling medium, is found to influence the nucleate boiling data in a manner similar to that of a dissolved gas. (auth)

39123 EXPERIMENTS ON TURBULENT HEAT TRANSFER IN A TUBE WITH CIRCUMFERENTIALLY VARYING THERMAL BOUNDARY CONDITIONS. Black, A. W.; Sparrow, E. M. (Univ. of Minnesota, Minneapolis). J. Heat Transfer, 89: 258-68(Aug. 1967).

An experimental investigation, supported by analysis, was performed to determine the heat transfer characteristics for turbulent flow in circular tubes with circumferentially varying wall temperatures and wall heat fluxes. Air was the working fluid. The desired boundary conditions were achieved by electric heating within the wall of a tube whose thickness varied circumferentially. In this way, ratios of maximum-to-minimum wall heat flux as large as

two were attained. Local heat transfer coefficients, deduced from the experimental data, display a circumferential variation that is substantially smaller than the heat flux variation. In general, lower heat transfer coefficients correspond to circumferential locations of greater heating, while higher coefficients correspond to locations of lesser heating. The predictions of prior analyses appear to overestimate the circumferential variation of the heat transfer coefficient. A specially designed probe was employed to measure the radial and circumferential temperature distributions within the flowing airstream. On the basis of these measurements, as well as from the heat transfer results, it is concluded that, in the neighborhood of the wall, the tangential turbulent diffusivity is greater than the radial turbulent diffusivity. The axial thermal development was found to be more rapid on the lesser-heated side of the tube than on the greater-heated side. Experimentally determined circumferential-average heat transfer coefficients agreed well with the predictions of analysis. (auth)

39124 RADIATION EFFECTS ON FILM BOILING IN NATURAL AND FORCED-CONVECTION BOUNDARY-LAYER FLOWS. Yeh, Hsu-chieh; Yang, Wen-jei (Univ. of Michigan, Ann Arbor). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/HT-6, 12p., $1.50. (CONF-661102-33). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

A theoretical analysis was made to determine the effects of radiation on the heat transfer and friction characteristics in the natural-convection film boiling on a vertical surface and the forced-convection film boiling over a flat plate. For both processes, two situations are taken into consideration: The liquid is either at the saturation temperature or subcooled. The two-phase flow and heat-transfer problems have been formulated exactly within the framework of boundary-layer theory with the consideration of the shear stress and vapor velocity at the liquid-vapor interface. Analytical results are obtained through the use of the similarity transformation. These results include the vapor-film thickness, skin friction, and heat transfer rate. The parameters which have a significant effect on the transport phenomena are identified. Numerical calculations are carried out for both forced and natural-convection saturated film boiling with the neglect of gas radiation in the vapor film. Only the effects of radiation between the plate surface and the fluid interface are taken into consideration. It is disclosed that the presence of radiation-exchange process results in an increase in the heat transfer rate and a decrease in the skin friction. (auth)

39125 FORCED-FLOW HEAT TRANSFER TO HIGH-PRESSURE WATER BEYOND THE CRITICAL HEAT FLUX. Quinn, E. P. (General Electric Co., San Jose, Calif.). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/HT-36, 13p., $1.50. (CONF-661102-27). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

A physical picture and governing parameters for heat transfer beyond the critical heat flux is developed. Experimental measurements for transition boiling, space-dependent film boiling, and fully developed film boiling are presented for water at 1000 psia above 20 percent quality. A method is given for estimating heat-transfer coefficients for fully developed film boiling. (auth)

39126 VOPROSY PRIKLADNOI RADIOGEOLOGII. VYPUSK 2. (Problems of Applied Radiogeology. Volume 2). Surazhskii, D. Ya. (ed.). Moscow, Atomizdat, 1967. 388p.

Fifteen articles are included on the mechanism of the formation of uranium minerals, paragenesis of mineral associations, and various types of uranium deposits. New data are given on the mineralogy and crystalline chemistry of radioactive elements, chemical processes for formation of uranium and thorium deposits, and possible sources of uranium deposits. Geochemistry of uranium, isotopic content of lead, genesis of brannerite ores, and common selenium and uranium geochemical properties are also discussed. (R.V.J.)

Isotope Technology

Refer also to abstracts 39047, 39084, and 39091.

39127 (MLM-1409) STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION: JANUARY-MARCH 1967. (Mound Lab., Miamisburg, Ohio). Mar. 31, 1967. Contract AT-33-1-GEN-53. 35p. Dep. CFSTI.

Developments in the separation and purification of stable rare gas isotopes by thermal diffusion and chromatography are described. The production of ^{21}Ne and ^{136}Xe by thermal diffusion and ^{136}Xe by chromatography is discussed. Transport coefficient determinations were continued for He, Kr, Ne, and Xe. Computer calculation showed that high ^{21}Ne enrichments could be obtained by using deuterated methane as an auxiliary gas and preliminary results support these calculations. Calculations predicting the characteristics of a U-tube superleak apparatus for ^{3}He separation from ^{4}He indicate that the upper limit of ^{3}He enrichment is reached because the required temperature gradient across the two arms would necessitate that the pure ^{4}He arm be above the lambda point and therefore no fountain pressure could be present. Recent thermal transpiration theory is discussed and a theoretical generalization is calculated. Measurements of the relative thermomolecular pressure difference for gaseous Ar, N and Co were made. The Ar and N data are incomplete but CO data showed changeable results indicating the need for an temperature dependent accommodation coefficient. (F.S.)

39128 (MMM-3691-20) SNAP-21 PROGRAM, PHASE II. DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM. Quarterly Report No. 4, April 1, 1967-June 31, 1967. Fox, F. K. (Minnesota Mining and Mfg. Co., St. Paul). July 1967. Contract AT(30-1)-3691. 139p. Dep. CFSTI.

Progress is reported on the SNAP-21 system design study. The generator A10D-z was completely assembled and found to have some fiberglass insulation sleeving short circuits which were corrected. Weld closures and the insulation system were completed. Radiation effectiveness of the biological shield was determined using a 200 W ^{90}SrO source. 214 couples including both the instrumented types and those with output tap assemblies were fabricated. Development work is continuing to improve the physical strength of the bond of the N- and P-leg couples during bonding through improved fabrication techniques. Test plans for compatibility testing of multi-layer insulation were completed, the test fixture was designed, and 500 of the 2000 hrs of testing were accomplished. Tests concerning the relationship between degradation in the resistance of the bias section of the thermopile and the starting characteristics of the power conditioner showed that the power conditioner operating at the rated load with a degradation of 2:1 in the thermopile bias section will not inhibit starting under normal operating load. Test sections for the electrically heated fuel capsules, laboratory corrosion specimens and the galvanic and marine fouling system components were fabricated. The results of ultrasonic tests on the first weld development closures on fuel capsules were evaluated. Some cold end heat transfer tests were completed. Conceptual drawings of the 20 W system were started. An updated design envelope for the 20 W high vacuum thermal insulation system was prepared. The thermoelectric leg geometry was determined to establish the size of the generator. (F.S.)

39129 (ORNL-4155) REVIEW OF RADIOISOTOPES PROGRAM, 1966. Gillette, J. H. (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 58p. Dep. CFSTI.

A review of the accomplishments of the Radioisotope Program at ORNL during 1966 is presented. The following topics are discussed: nuclear reactor studies for producing radioisotopes, radioisotope separations and purification development, sand movement studies, radioisotope source development, radioisotope source safety testing, activities of the Isotopes Information Center, and isotope production and sales. (R.C.K.)

39130 (ORNL-P-3189) CONSEQUENCES OF INTERNAL HEAT FLOW IN RADIOISOTOPE HEAT SOURCES. Posey, J. C. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 7p. (CONF-670714-5). Dep. CFSTI.

From 2nd International Symposium on Nucleonics in Aerospace, Columbus, Ohio.

Equations relating the maximum internal temperatures of various-shaped fuel forms and other source parameters are given. By using calculated results, the use of cermets is compared with the use of oxide-metal laminar structures as methods of decreasing the resistance to heat flow in the interior of heat sources and achieving higher surface heat fluxes without exceeding maximum allowable internal temperatures. The laminar composite fuel form is moderately superior. The expected vapor phase migration and equilibrium distribution of a volatile radioactive fuel inside a heat source capsule is described. Redistribution does not always result in serious problems and can reduce the cost of source fabrication. (auth)

39131 (ORNL-TM-1905) THERMAL CONDUCTIVITIES OF ^{90}Sr HEAT SOURCE MATERIALS. Ketchen, E. E.; McHenry, R. E. (Oak Ridge National Lab., Tenn.). Sept. 1967. Contract W-7405-eng-26. 22p. Dep. CFSTI.

The thermal conductivities of SrO, Sr_2TiO_4, and $SrTiO_3$ (of a composition which simulates these compounds prepared from nu-

clear fission fuels waste) are reported. The thermal conductivities were measured using a comparator apparatus which was altered to evaluate several factors necessary to establish a procedure for the measurement of the thermal conductivities of radioactive heat source fuel. The errors in the reported values are assessed and a procedure for high power density radioactive samples is described. (auth)

39132 (RCC-R-195(Rev.)) TESTING THE SOURCE CAPSULE FOR THE RIPPLE III GENERATOR FOR APPROVAL AS "SPECIAL FORM" (I.A.E.A. TRANSPORT REGULATIONS). Ansell, K. H. (Radiochemical Centre, Amersham (England)). Dec. 1966. Revised June 1967. 14p. Dep. CFSTI. UK 2s. 6sd.

The RIPPLE III source was the first capsule to be approved in the UK as "special form." The tests necessary to obtain this certificate of approval are described. (auth) (UK)

39133 (TID-23964) THERMOELECTRIC LEG PRODUCT SPECIFICATION (TELPS) MIDTERM TECHNICAL REPORT. Black, J. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). [nd]. Contract AT(30-1)-3535; Subcontract 028-E22009. 93p. Dep. CFSTI.

Technical results of performance tests and material characteristics of thermoelectric legs for SNAP-27 are reported. N-type PbTe and P-type PbSnTe legs were tested. Some differences appeared and it is anticipated that some cause and effect correlation will be found. A decrease in resistance and voltage and an increase in power were observed. Performance of N-type legs is generally good and quite reproducible from one leg to the next except for two exceptions which displayed significantly lower Seebeck voltages with no compensating effect in resistance. This resulted in a 10% lower calculated power output. (F.S.)

39134 (AEC-tr-6902) METHOD FOR SEPARATING GASES WITH THE AID OF A FEED VAPOR PUMP. Translated from German Patent 1,203,234. 8p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

A method is described for separating gases, especially isotopes, with the aid of a feed vapor pump, characterized by a pre-vacuum pump pressure regulated and maintained to values between the boundary values of pre-vacuum stability of the gas fractions to be separated. In the pump arrangement, the heavier isotope is enriched in that chamber toward which the vapor streams while the lighter isotope remains in a high-vacuum chamber of the diffusion pump from where it is removed by an auxiliary pump. (M.C.G.)

39135 DESIGN OF CASCADES FOR THE SEPARATION OF MULTICOMPONENT ISOTOPIC MIXTURES. Minenko, V. P. At. Energ. (USSR), 22: 321-3(Apr. 1967). (In Russian).

Cascades consisting of sections having a rectangular profile are ordinarily used to separate isotopes. The degree of change of the isotopic mixture flow L at the boundaries of the section, and the degree of change of the positions and concentration maxima of the intermediate mass components are important variables. In order to eliminate the necessity of varying the number of stages (s) in a section, it is desirable to obtain equations for the concentrations that do not contain s in explicit form. A material balance of the flow is constructed, and separation factors are introduced in place of s. A set of successively related solutions of a set of algebraic equations is derived from which the section length can be determined. (TTT)

39136 DETERMINATION OF THE C/H RATIO IN HYDROCARBONS USING BETA- OR NEUTRON RADIATION: COMPARISON OF THE EFFICIENCIES. Brunner, G. (Deutsche Akademie der Wissenschaften, Berlin). Isotopenpraxis, 3: 220-3(June 1967). (In German).

The main result of the sensitivity studies executed on the basis of the neutron age theory is that in the hydrogen (or moisture) determination by means of neutron radiation the effect of impurity atoms in good approximation may be regarded as addition of absorbers only. Quantitative results are given and compared with the corresponding dates of beta technique. (auth)

39137 SOME RECENT WORK CARRIED OUT BY THE INDUSTRIAL ADVISORY DEPARTMENT OF THE AUSTRIAN REACTOR CENTRE, SEIBERSDORF. Cless-Bernert, T. (Abteilung Industrieberatung/Isotopenanwendung des Reaktorzentrums, Seibersdorf, Austria). Isotopenpraxis, 3: 217-20 (June 1967). (In German).

For stimulating industrial applications of isotopes, the Industrial Advisory Department of the Austrian Reactor Center has executed investigations taking advantage of isotopic labelling and other methods for some years. Some examples of the activity of this institution are given: autoradiographic and radiometric determination of boron in borated steels, determination of the distribution of asbestos fibers in asbestos-cement plates and of bitumen spray under the concrete plates of highway lanes, construction of a movable beta irradiation chamber of 1 MRAD/h. (tr-auth)

39138 AUTORADIOGRAPHY AS APPLIED FOR DETERMINING THE SHAPE OF THE SOLIDIFICATION FRONT IN SEMI-CONTINUOUS ALUMINIUM CASTING. Akerman, K.; Brafman, M.; Kruszewska, O.; Kruszewski, K. (Inst. for Nuclear Research, Warsaw). Isotopenpraxis, 3: 211-17(June 1967). (In German).

An autoradiographic technique for determining the shape of the solidification front of molten aluminium as a function of the dimensions of the aluminium and the conditions of operation has been developed. At the end of casting ^{65}Zn is added to the fused metal the microdistribution of which on the liquid-solid interface makes possible determining the shape of the solidification front by autoradiography. The method developed can be employed when the optimal characteristics of the continuous casting technique are to be determined as a function of the dimensions of the aluminium bar and its metallic composition. (tr-auth)

39139 SEPARATION OF HYDROGEN AND NITROGEN ISOTOPES BY ADSORPTION ON SYNTHETIC ZEOLITES. Kochurikhin, V. E.; Zel'venskii, Ya. D.; Loseva, T. I. (Khimiko-Tekhnicheskii Institut, Moscow). Isotopenpraxis, 3: 181-4(May 1967). (In Russian).

The equilibrium single-process separation factors of the mixtures H_2/D_2 (relative abundance 20 to 30 at. % D) and $^{14}N_2/^{14}N^{15}N$ (natural abundance of nitrogen) by adsorption on the synthetic zeolites of A type in the Mg, Ca, Zn, and Cd form have been measured in the temperature range from 77 to 100°K. The separation factor was also studied as a function of pressure. (tr-auth)

39140 ON THE PREPARATION OF ^{57}Co MOESSBAUER SOURCES. Dezsi, I.; Molnar, B. (Central Research Inst. for Physics, Budapest). Nucl. Instrum. Methods, 54: 105-8(Sept. 1967).

A method developed for the preparation of ^{57}Co sources appropriate for Mössbauer effect measurements is described. Investigations were performed to establish the ^{57}Co electrodeposition rate on stainless steel, Cu, Fe and Pd surfaces. The efficiency of the electrodeposition to adequately pretreated surfaces was found to be better than 90%. The total ^{57}Co activity deposited on the surface can be diffused into the metal. The width of the 14.4-MeV gamma line emitted from the source does not exceed the theoretical value by more than 50%. Using a stainless steel absorber of 21 mg/cm^2 thickness, the intensity of the effect is found to be 50%. (auth)

39141 RADIOISOTOPES AS POWER SOURCES. OECD (Org. Econ. Coop. Develop.) Observ., No. 24, 49-53(Oct. 1966).

Development of radioisotope power sources by European nations is reviewed. A series of isotopic generators called RIPPLE (Radio Isotope Power Pulsed Light Equipment), intended to provide power for marine navigation lights, was built in the United Kingdom. These generators provide 2-W power and are now in experimental operation with Xe flash tubes which give light at a range of 2 mi. In France, a low-power demonstration generator is under construction, while Euratom, at its Ispra Center, is building an experimental prototype 5-W unit. Isotopic generators have also been constructed in the USSR. A European Nuclear Energy Agency report has recommended that work should be concentrated on 3 types of isotopic generator: a terrestrial generator of original design with high power (of the order of several electrical kilowatts) using fission products and dynamic conversion machines; a form of radioisotopic battery for medical and other industrial applications; and compact high-performance generators using either ^{238}Pu or ^{227}Ac as heat source. Advantages of the different types are discussed, particularly from economic aspects. Their intrinsic advantages of long life, reliability, and freedom from maintenance make isotopic generators of great potential interest both from the technical and economic points of view. The safety aspects of the various radioisotopic power generators are also considered. (BBB)

39142 ISOTOPES AND RADIATION TECHNOLOGY. Volume 4, Number 3. Baker, P. S.; Lafferty, Robert H. Jr.; Gerrard, Martha; Greene, R. E.; McKinney, F. E.; Carden, Joan E.; Miller, F. J.; Rupp, A. F. (eds.). Contract W-7405-eng-26. One of the five Quarterly Technical Progress Reviews published for the Division of Technical Information, USAEC. Oak Ridge, Tenn., Oak Ridge National Lab., Spring 1967. 111p. GPO $0.70 Domestic, $0.90 Foreign.

Fifteen articles are included; separate abstracts were prepared for each. One abstract on stable-isotope enrichment by gas chromatography was not included in NSA. (P.C.H.)

For abstracts of individual papers see: 38912, 38991, 39011, 39085, 39143–39149, 39282, 39283, 39477, and 39478.

39143 THE U. S. RADIOISOTOPE INDUSTRY: 1966. Isotop. Radiat. Technol., 4: 207-14(Spring 1967).

The status of the commercial U.S. radioisotope industry in 1966

is reviewed in four categories: producers, processors, source fabricators, and equipment manufacturers. Among the significant actions taken during the year by both the AEC and industry which should strengthen the industry both now and in the future were the following: AEC withdrawal from the production of 19 more isotopes, bringing to 34 the total number of isotopes that are no longer produced and sold by the AEC; first production of ^{60}Co in a commercial power reactor was started; Martin Marietta Corp. announced a fixed-price isotope-powered generator for sale and sold the first unit to the Navy. (auth)

39144 COMPILATION OF BETA-EXCITED X-RAY SPECTRA. Miller, F. J. Isotop. Radiat. Technol., 4: 243-9(Spring 1967).

A selected number of beta-excited X-ray sources were fabricated and their spectrums compiled. Thirty-one target elements were used, with ^{147}Pm, ^{45}Ca, and ^{32}P as the beta emitters. Standardization was maintained by holding the assay parameters, such as the detectors and the geometry, constant. The parameters were recorded throughout so that spectrums from variants of a single source type could be compared to each other, as could different source types. The basic source types used were the apposition, the mixture, and the compound. The compilation is intended to provide a convenient and rapid qualitative as well as quantitative reference for the worker using the beta-excitation phenomenon. (auth)

39145 USE OF RADIOISOTOPE TECHNIQUES IN SWEDEN. Erwall, Lars G. (Isotope Techniques Lab., Stockholm). Isotop. Radiat. Technol., 4: 255-8(Spring 1967).

Radiotracer work in Sweden is carried out under both government and private-industry sponsorship. As examples of the fields of activity, the uses of radiotracers in industrial processes, furnace-lining wear, and water pollution, in identifying metal products, and in activation analysis are discussed. (auth)

39146 RADIATION PROCESSING: WHERE WE STAND NOW. Harmer, David E. (Dow Chemical Co., Midland, Mich.). Isotop. Radiat. Technol., 4: 265-70(Spring 1967).

Surveys of published literature indicate that a large number of radiation processes are either commercial or are in advanced development stages. It may be concluded that a radiation process industry is really operating, even if on a rather tentative scale. It may also be extrapolated that the known processes signify others which have not yet been made public but which may soon serve to broaden the scope of radiation as a processing tool. (auth)

39147 SINB AND USAEC HOLD FOOD-IRRADIATION BRIEFING FOR INDUSTRY AT OAK RIDGE. Isotop. Radiat. Technol., 4: 271-4(Spring 1967).

The conference on food irradiation held in Oak Ridge, Tennessee, on February 2 to 3, 1967 is summarized. The conference was sponsored by the Atomic Energy Commission and the Southern Interstate Nuclear Board to acquaint industry representatives with recent technological developments in radiopreservation of food. (R.C.K.)

39148 AEC–ORNL SOURCE SAFETY TESTING PROGRAM. Robinson, R. A. (Oak Ridge National Lab., Tenn.). Isotop. Radiat. Technol., 4: 281-94(Spring 1967).

The AEC–ORNL Source Safety Testing Program is designed to test a wide variety of sources and to set up a schedule of source-testing criteria to be used as guidelines for preparing, testing, and evaluating radioisotope sources. (auth)

39149 USE OF LARGE RADIOISOTOPE SOURCES IN CANADA, UNITED KINGDOM, AND JAPAN. Gerrard, Martha. (Oak Ridge National Lab., Tenn.). Isotop. Radiat. Technol., 4: 295-301(Spring 1967).

Information on the use of large radioisotope sources in Canada, the United Kingdom, and Japan is presented. Work in Canada on radiopreservation of potatoes, radiosterilization of pharmaceuticals, chemical synthesis, and cobalt-60 teletherapy is summarized and the mobile ^{60}Co food irradiator described. The Wantage Laboratory package irradiation plant in England, sterilization of medical supplies, food processing, acceleration of chemical processes, ^{60}Co teletherapy, and research on heat sources for navigational lights are briefly described. Work in Japan has been concentrated on producing and improving the properties of high-molecular weight materials by means of radiation. (F.S.)

39150 IMPROVEMENTS IN OR RELATING TO IRRADIATION UNITS. Jones, Patrick Leonard (to Nuclear Engineering Ltd.). British Patent 1,078,431. Aug 9, 1967. Filed Apr. 10, 1963.

An irradiation unit is described in which source material is located in an irradiation zone or chamber within a shielding mass. Source material is not withdrawn during loading or unloading of the material to be irradiated. A tunnel is provided in the shielding mass along which the material to be irradiated is conveyed to and from the radiation source material. The tunnel follows a path that curves or changes direction so that radiation does not escape from the shielding mass. The tunnel usually follows a circular path with an access area diametrically opposed to the source material. (F.S.)

39151 METHOD OF PREPARATION OF ^{137}Ba. Bonnin, Andre Marie Alain; Yordamian, Stefane Gerard Ahtonin (to Saint Gobain Techniques Nouvelles). British Patent 1,080,454. Aug. 23, 1967. Priority date Nov. 8, 1963, France.

A method of preparing ^{137}Ba starting from ^{137}Cs is described. The method is characterized by successive stages of ^{137}Cs fixation on solid ferrocyanides of transition elements ($21 \geq Z \leq 29$). The ^{137}Ba is eluted from the fixed ^{137}Cs using NaCl solutions containing calcium gluconate and calcium levulinate. (J.R.D.)

39152 ISOTOPENTECHNIK UND TEXTILINDUSTRIE. LITERATURNACHWEIS. (Isotope Technology and Textile Industry. Literature Review). van Wauwe, O.; Brandenburg, D. Informationsheft des Buero Eurisotop, 6. Serie: Bibliographien-2. Brussels, EURATOM, 1965. 206p. 10 D. M.

One hundred and eight references on radioisotopes in the textile industry are presented and then arranged according to the following subjects: review articles, use of radioactive tracers, activation analysis, irradiation, radiation-chemical processes, measurement methods by radiation absorption, and reduction of static electricity. Subject and author indexes are included along with a list of organizations, institutes, and industries. (M.C.G.)

Materials Testing

Refer also to abstracts 39069, 39078, 39132, 39654, 40737, 40750, and 40758.

39153 NEUTRON RADIOGRAPHY AND MICRORADIOGRAPHY STUDIES. Fahmy, A. A. (American Univ., Cairo). pp 537-51 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

The technique of neutron radiography and microradiography depends on the attenuation of neutron beams by matter. The similarities and differences between this technique and x- and gamma-ray radiography are pointed out. The physical principles on which the technique is based are discussed, and the different methods of obtaining the radiograph are described and compared. Resolution pieces were made and used to ascertain the resolution of which the radiographic method is capable, independent of the nature of the object. Specimens of boral, a composite material of B_4C in an aluminum matrix, in the cast and rolled conditions were radiographed with x rays and neutrons and the radiographs compared. By setting up conditions for high resolution and using an extremely fine-grained film, it was possible to obtain neutron radiographs capable of 100x magnification, revealing microstructural features of the alloy. The technique is evaluated and found to be useful and practical in certain circumstances. (auth)

Protective Structures

Refer also to abstract 39623.

39154 (AD–650323) DEVELOPMENT OF STANDARD FIRE TEST RATING SYSTEMS FOR SHELTER COMPONENTS. Final Report, September 30, 1963–February 20, 1966. Labes, Willis G.; Waterman, Thomas E.; Varley, Reed B. (IIT Research Inst., Chicago, Ill.). Dec. 1966. Contract OCD-PS-64-50. 164p. (IITRI–N6061). CFSTI.

Fire tests for the purpose of rating structural components of blast shelters and fallout shelters are considered. Existing fire test procedures for building construction and materials door assemblies, and window assemblies are analyzed to determine how results from these tests may be applied toward the development of a system for rating shelter components. Shelter component performance requirements in regard to heat transmission, smoke and toxic gas build-up in shelter areas, and fire spread and structural collapse are described. Fire exposures for the rating of shelter components are described and classified according to their characteristic modes of heat transfer. The sources of these exposures, described as exposures from fire within the shelter building, from fire in individual nearby buildings, from mass fire, and from debris fire, are analyzed and interim data presented on exposure severity. A useful concept for the comparison of fire exposures, based upon their effects on each type of component, is defined. (TAB)

39155 (IITRI-M-6088) SHELTER EVALUATION PROGRAM, Final Report. Heugel, W. F.; Feinstein, D. I. (IIT Research

Inst., Chicago, Ill.). Feb. 1967. Contract OCD-PS-64-50. 93p. CFSTI.

A computer model is described which has been developed in order to study the comparison of alternate shelter systems in terms of injuries and mortalities sustained by personnel from prompt nuclear weapon effects. These effects include blast, translation, debris, thermal energy and prompt ionizing radiation. Shelter systems include any grouping of above ground structures and their relationship to surrounding contiguous structures. Effects both outside and inside the shelter are evaluated. Hiroshima data compared favorably with model predictions, thus demonstrating a sound basis for studying high yield weapons. High yield weapon effects were studied with respect to their effect on various shelter systems and the results are reported herein. (auth)

39156 (NP-16877) TEST AND EVALUATION OF COMPUTER ANALYSIS PROGRAMS FOR SHELTERS IN BUILDINGS. Final Report. Weissman, Samuel; Di Napoli, Pat; Cohen, Edward (Ammann and Whitney, New York). May 1967. Contract OCD-PS-65-72. 104p.

Four computer programs for the engineering analysis or review of protective structures used for civil defense were tested and evaluated. Each of the programs was found to be useful if applied by an engineer familiar with the programs and their operation. The fallout program can be used with the best amount of experience and is suitable for research design or review of protective structures. The blast programs useful in research, design, and review require a background in dynamics, ultimate strength, plastic design, and familiarity with the programs. The fire program is most useful as a research tool to evaluate various types of construction, postattack buildings, and existing buildings. This program should be used by engineers familiar with the nomenclature and the basis for the analysis. Recommendations are made for modifications of input data sheets, supplementing input data instructions, extending existing programs, and implementing the programs. (F.S.)

39157 (NP-17014) ACTIVE ARCHING OF SAND DURING DYNAMIC LOADING. Results of an Experimental Program and Development of an Analytical Procedure. Gill, H. L. (Naval Civil Engineering Lab., Port Hueneme, Calif.). Sept. 1967. 33p. (R-541). CFSTI.

Soil arching was studied to determine an economic design of reliable underground protective structures. Idealized small-scale structures were embedded in prepared specimens of dry sand, and long-duration, dynamic overpressures of various magnitudes up to 440 psi were applied to the surface of the sand. Foundation area and depth of soil cover over the structures were the primary variables during the tests. Measurements were made to evaluate the interrelationships between depth of soil cover, dynamic overpressure, soil stiffness, structural response, and soil arching. Soil arching over a particular soil-structure system subjected to dynamic loading was found to be a function of the geometry and the relative stiffness of that system. The geometry is accounted for by the perimeter-area ratio of the structure multiplied by the depth of the soil cover. The stiffness portion of the factor relates the soil stiffness to the stiffness of response of the structure relative to the free-field soil. (auth)

39158 (AEC-tr-6858, pp 1-10) PROTECTION BY CONCRETE AGAINST A-BOMB RADIATION SICKNESS IN HIROSHIMA CITY. Murachi, Koichi; Mural, Takeo. Translated from pp 467-77 of Collection of Investigation Reports on Atomic Bomb Disaster, Volume 1, Japan Science Promotion Society, 1953.

The investigation of personnel who were located in several tunnel-type air raid shelters dug into a hill near Nagasaki Prison is reported. The prison was located near the bomb epicenter. At the time of the blast 52 men and women were located in one tunnel; seven survived. A girl, alone in one tunnel, and two men in another tunnel also survived. (F.S.)

39159 (AEC-tr-6858, pp 11-13) A-BOMB HUMAN CASUALTIES IN A BUILDING LOCATED LESS THAN 200 m FROM THE HYPOCENTER. Kitamoto, Osamu; Ishikawa, Koich. Translated from pp 483-6 of Collection of Investigation Reports on Atomic Bomb Disaster, Volume 1, Japan Science Promotion Society, 1953.

A detailed study is reported on human casualties and the effects of radiation on a single group of people who were in a reinforced concrete structure located 160 to 180 m southeast of the atomic bomb hypocenter in Hiroshima. (F.S.)

39160 (AEC-tr-6858, pp 14-17) A-BOMB DISASTER INVESTIGATION. 1. DISASTER INVESTIGATION WITHIN TUNNEL-TYPE AIR RAID SHELTER IN HILL NEAR NAGASAKI PRISON. Urabe, Miyoshi; Ohashi, Shigeru; Ueda, Hideo; Hakamada, Saburo; Nikaido, Soshiro. Translated from pp 487-91 of Collection of Investigation Reports on Atomic Bomb Disaster, Volume 1, Japan Science Promotion Society, 1953.

Representative concrete structures in Hiroshima City at various distances from the bomb blast center were selected and information was collected from and about the occupants of the building. The information is primarily related to the protection offered by the concrete structures. Buildings selected were the Bankers Club, Bank of Japan, Central Telephone Office, Chugoku Power Building, JOFK studio, and the Communications Office and the Hospital. The buildings were located 280 to 1350 m from the bomb center. (F.S.)

39161 INTERNAL CONTAMINATION OF BUILDINGS BY FALLOUT. Newman, John (Oak Ridge National Lab., Tenn.). Health Phys., 13: 991-9 (Sept. 1967).

Quantitative assessment of the possible loss of radiation protection in above ground fallout shelters due to window breakage and internal contamination requires consideration of the mechanism of the settling of fallout, the radiation shielding of buildings, distances of blast damage, and wind characteristics. These factors are discussed in a manner which would allow assessment for a particular area with fallout shelters in tall buildings. In a particular example of a seven-story building, the internal contamination on each floor is estimated to be 2.5% of that on the roof. This contamination, if spread uniformly over the floor, reduces the protection factor on the fifth floor from 28 to 18 and in the unexposed, uncontaminated basement from 420 to 200. (auth) (UK)

Radioactive Material Handling

Refer also to abstracts 39077, 39401, 40351, 40656, 40718, and 40760.

39162 (AECL-2710) PHILOSOPHY AND PRACTICE OF WASTE MANAGEMENT AT CRNL. Mawson, C. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Feb. 1967. 21p. Dep. CFSTI. CAN $1.00.

The development of waste management practices at CRNL is outlined. The policy has been to develop a system that could be operated safely at a site close to a built-up area and to demonstrate the construction and use of facilities that can be made and operated at a reasonable cost. The waste facilities and the experiments designed to test the behavior of fission products moving through the ground water zone are described. Other experiments on dispersion of radionuclides through the environment are outlined. The basis for setting working limits for certain types of disposals is given, especially the connection between maximum discharge levels to the river and the MPC_w recommendations of the ICRP. It is shown that waste at present pumped to Reactor Pit 2 could be discharged to the river without approaching the ICRP limits, but this would cause a large increase in the measured levels of Sr-90 and Cs-137 in the river water. (auth)

39163 (BNL-11508) DISPOSAL OF CHEMICAL AND RADIOACTIVE WASTE. Pearsall, S. G.; Wilshusen, W. (Brookhaven National Lab., Upton, N. Y.). [1966]. 26p. (CONF-670623-1). Dep. CFSTI.

From National Conference on Campus Safety, Lincoln, Neb.

A discussion of the problems of disposal of chemical and radioactive waste materials is presented. An organization charged with disposal responsibilities is necessary for the disposal of waste chemicals and radioactive materials at any institution where these materials are used. The primary purpose of this group is to assure that these materials are removed from the point of production and eventually removed safely from the plant. In order to accomplish this, the person responsible must be familiar with the options for disposal which are open to him because of law, location and hazard. He must also be familiar with the techniques for exercising these options. Any local disposal operator must think first in terms of safely to personnel. In many cases the techniques used will not be that which is necessarily either the least expensive or the easiest, but that which most safely will complete the disposal. At the same time, however, every effort should be made to eliminate the air and water pollution wherever possible, particularly where repetitive operations of a routine nature are carried on. With this in mind, it is possible by careful planning and good techniques to dispose of most wastes safely and sensibly with a minimum of pollution of the environment. (F.S.)

39164 (ORNL-3816) LABORATORY DEVELOPMENT OF PROCESSES FOR FIXATION OF HIGH-LEVEL RADIOACTIVE WASTES IN GLASSY SOLIDS. (4) CORROSION STUDIES ON CANDIDATE MATERIALS OF CONSTRUCTION. Clark, W. E.; Hess, D. N.; Neumann, P. D.; Rice, L.; English, J. L. (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 37p. Dep. CFSTI.

Laboratory test results indicate that austenitic stainless steels, particularly type 304L, can be used as the solidification and storage vessel for the calcination and, with caution, the melting to

form a glass or a ceramic solid of aluminum-containing (TBP-25) and sulfate-containing (Purex) waste types. Temperatures of operation should be kept ≤900°C; waste and additive compositions must be known, and operational control must be good in order to avoid corrosion difficulties. Corrosion during storage in a salt mine should be no problem provided the salt is relatively dry. Titanium was superior both to the stainless steels and to the nickel alloys for service in a waste evaporator and its condenser. Both stainless steel and nickel alloys developed intergranular attack, which was accelerated by the presence of fission product quantities of ruthenium. The presence of appreciable concentrations of uncomplexed fluoride would be expected to increase the corrosion of all these alloys markedly, but its effect on titanium would be proportionally greater. (auth)

39165 (ORNL-tr-1692) TRANSPORT OF FISSILE MATERIALS AND CIVIL LIABILITY IN NUCLEAR MATTERS. Belli, Giuseppe. Translated for Oak Ridge National Lab., Tenn., from Atomo, Petrol. Elet., 63-5(1959). 8p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

Aspects of civil liability in transporting fissile materials by surface, sea, and air are discussed. Points of view considered include those of the suppliers, users, carriers, the insurance companies for transportation, and international organizations as affected by their agreements with each other. (F.S.)

39166 RADIOACTIVE WASTES: THEIR TREATMENT AND DISPOSAL. Burns, R. H. (Atomic Energy Research Establishment, Harwell, Eng.). Purdue Univ., Eng. Bull., 50: Ext. Ser. No. 121, 714-43(Mar. 1966).

From 21st Annual Purdue Industrial Waste Conference, Lafayette, Ind., May 3–5, 1966. See CONF-660523-(Pt.2).

Discussions of maximum permissible concentrations of radioisotopes in water supplies, sources of wastes, waste dispersal, and waste treatment are presented. It is concluded that present methods of waste disposal are adequate and safe. (J.R.D.)

39167 THE BEHAVIOR OF ^{90}Sr AND ^{137}Cs IN SEEPAGE PITS AT ORNL. Lomenick, T. F.; Jacobs, D. G.; Struxness, E. G. (Oak Ridge National Lab., Tenn.). Health Phys., 13: 897-905(Aug. 1967). (ORNL-P-2628).

At the Oak Ridge National Laboratory approximately 40,000 Ci of ^{90}Sr and 150,000 Ci of ^{137}Cs are contained in the vicinity of two intermediate-level liquid waste seepage pits that are no longer receiving input of liquid wastes. Radiochemical analyses of cores taken within the area indicate that most of the activity is associated with the soft sludges and precipitates and the first few inches of weathered shale that comprise the side walls and bottoms of the pits. Concentrations of ^{137}Cs and ^{90}Sr were found to be as high as 96 μCi/g (dry weight) and 70 μCi/g, respectively, in the sludge, and 415 μCi/g and 32 μCi/g in the first few inches of weathered shale on the side walls and bottom of the pits. The sludge is primarily a mixture of calcium carbonate and illitic clay, with calcium carbonate comprising about 20–50% of the weight. Most of the ^{90}Sr in the sludge is associated with the calcium carbonate, probably as a coprecipitate, while the ^{137}Cs occupies selective exchange sites of the illitic clay. With tritiated water as a tracer, it has been observed that the normal rate of groundwater movement in the waste-pit area is about 0.5 ft/day, with a dispersion coefficient of approximately 6×10^{-3} cm^2/sec. Predictions of radionuclide movement and dispersion with time have been made, based on the exchange properties of the Conasauga shale for calcium and the critical radionuclides. The predicted migration agrees closely with experience to date and suggests that movement of radiostrontium and radiocesium is not likely to present serious contamination problems in nearby surface streams in the future. (auth) (UK)

39168 DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTES INTO THE OCEANS. Parker, F. L. Nucl. Safety, 8: 376-82 (Summer 1967).

Disposal of low-level radioactive wastes into the oceans is increasing, but to date such disposals are negligible in comparison with fallout in the ocean. Internal doses to populations have limited discharge in some cases, but external doses have also limited the discharges from other sites. The effect of such discharges on the biota has not yet been resolved. 60 refs. (auth)

39169 CURRENT PRACTICES IN THE DISPOSAL OF RADIOACTIVE WASTES FROM FUEL-FABRICATION FACILITIES. Brooksbank, R. E.; McDuffie, W. T. Nucl. Safety, 8: 385-90 (Summer 1967).

The current practices employed by typical commercial nuclear fuel-fabrication firms in the United States in storing and handling wastes are reviewed. Both the sources and the types of waste generated in normal fuel-fabrication operations by a 13-member group of firms surveyed by questionnaire and personal contact are described. Typical practices and techniques followed in handling, storage, and disposal of wastes, include baling and/or drumming of compressible wastes, incineration of combustible wastes coupled with incorporation of the ash in concrete in steel drums equipped with heavy-duty forged closure rings, incorporation of both liquid and solid noncombustible wastes in concrete or concrete-vermiculite mixtures in steel drums, and the treatment and disposal of the large-volume wastes, such as ventilation air and cooling water. The health and safety aspects of these are discussed briefly, and applicable regulations are included in the list of references. (auth)

39170 PROCEEDINGS OF THE TWENTIETH INDUSTRIAL WASTE CONFERENCE, PURDUE UNIVERSITY, LAFAYETTE, INDIANA, MAY 4, 5, AND 6, 1965. Purdue Univ., Eng. Bull., 49: Ext. Ser. No. 118, 1-803(July 1965). (CONF-650539).

A total of 66 papers were presented at the conference. Most of the papers are concerned with sanitary waste problems. One paper concerning radioactive waste disposal in salt mines was previously abstracted in Nuclear Science Abstracts as abstract 21751 in Vol. 19. (J.R.D.)

39171 FOAM ENCAPSULATION METHOD OF NUCLEAR REACTOR SAFETY. Silverman, L. (to U. S. Atomic Energy Commission). U. S. Patent 3,338,665. Aug. 29, 1967.

A method is described for treating gaseous fission products containing particulates released from a nuclear reactor for the purpose of absorbing the fission gases and encapsulating the particulates. A very high expansion foam is utilized which contains an ingredient which reacts with gaseous iodine producing a solid reaction product. The particulate is trapped in the walls of the bubbles and when the foam subsides all solid material remains trapped in the residue. (AEC)

Vacuum Engineering

39172 ROTATING PASSAGE FOR USE IN ULTRAHIGH VACUUM. Saglio, R. (INSA, Lyon); Pinard, P.; Davoine, F.; Thome, P. Vide, 22: 161-4(May-June 1967). (In French).

An apparatus was built which allows the speed of rotation of a moving assembly placed inside an ultrahigh vacuum container to be varied from 0 to V_{max}. It provides a couple variable between 0 and C_{max}, and V_{max} and C_{max} depending upon the geometry of the apparatus. (tr-auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 39482, 40112, 40142, 40357, 40421, 40429, and 40473.

39173 (ABS-THH-1022) FLUSSMESSUNGEN MIT DER DOPPELSONDEN-METHODE. (Flux Measurements With the Double-Probe Method). Stiller, G. (Technische Hochschule, Hanover (West Germany). Arbeitsgruppe fuer Bautechnischen Strahlenschutz). July 1965. 19p. (In German). Dep.

The techniques of the double-probe method are described and the experimental determination of the conversion factors for flux and count rate is discussed. The flux measurements made with the cadmium difference method and the double-probe method in a shielding experiment were compared, and the results agree within the limits of error. The flux values determined by both methods show about the same deviations from the calculated flux pattern. (J.S.R.)

39174 (AE-292) TOTAL AND DIFFERENTIAL EFFICIENCIES FOR A CIRCULAR DETECTOR VIEWING A CIRCULAR RADIATOR OF FINITE THICKNESS. Lauber, A.; Tollander, B. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Aug. 1967. 46p. Dep. SWED.

Total and differential detection efficiencies were computed for a circular detector viewing a circular radiator of finite thickness. Isotropic, cosinus, and n-p scattering angular emission distributions of the radiated particles are considered. Tables are given for the total efficiencies as well as for the differential efficiencies in the n-p scattering case. (auth)

39175 (AERE-R-5486) CAVITATION NUCLEATION BY ENERGETIC PARTICLES. West, C. (Atomic Energy Research Establishment, Harwell (England)). June 1967. 20p. Dep. CFSTI. UK 3s. 6d.

Some recent work on neutron induced cavitation is reported. A brief description is given of the apparatus used to generate a high amplitude ultrasonic field, and of the electronic system. In addition to experiments using an isotope source of neutrons (both slow and fast), some preliminary work with a pulsed D-T generator is described. The problem of nucleation by radiation is discussed and the differences between bubble chambers (where Seitz's theory has been applied with considerable success) and cavitation are outlined. An alternative approach which becomes identical with Seitz's theory for the positive pressure bubble chamber case is considered. Agreement with existing experimental data is improved, but remains quantitatively poor. (auth) (UK)

39176 (BMwF-FBK-67-61) EINE IMPULSDIVISIONSSTUFE FUER ANWENDUNGEN BEI ORTSEMPFINDLICHEN DETEKTOREN. (A Pulse Division Circuit for Use with Position-Sensitive Detectors). Kuhlmann, W. R. (Cologne Univ. (West Germany). Institut fuer Kernphysik). July 1967. 16p. (In German). Dep.

For experiments with detectors, which give an analog information about the spot, where the particle has entered the detector, an electronic pulse division circuit was evaluated. The circuit derives an output pulse $U_Q \sim \ln |U_1/U_2|$ from two coincident input signals U_1 and U_2. These may vary in a range $1.0\ V \leq U_i \leq 10\ V$ while $|U_1/U_2|$ varies from 1.2 to 4.0. The output pulses may be analyzed directly by a pulse-height-analyser. (auth)

39177 (BNL-11572) MAN-MACHINE COOPERATION IN DIGITAL PATTERN RECOGNITION OF BUBBLE CHAMBER TRACKS. Strand, R. C. (Brookhaven National Lab., Upton, N. Y.). June 1967. 36p. (CONF-670635-1). Dep. CFSTI.

From Conference on Data Extraction and Processing of Optical Images in the Medical and Biological Sciences, New York.

Conventional bubble chamber data extraction and processing and semiautomatic data extraction, which uses part manual track recognition and part computer track recognition, are discussed. The design and implementation of the track recognition programs are also discussed. (W.H.K.)

39178 (BNL-11645) SEMICONDUCTOR LIFETIME MEASURING APPARATUS. Rogers, E. J. (Brookhaven National Lab., Upton, N. Y.). [nd]. 5p. Dep. CFSTI.

An apparatus is described which measures the minority carrier lifetime of the germanium used in solid-state radiation detectors. Minority carriers are generated in a sample slab of the material by photo-excitation from a pulsed neon lamp while a steady current is applied to the slab. The voltage signal across the slab is monitored by an oscilloscope so that minority carrier decay can be observed directly. (W.H.K.)

39179 (BNWL-494) USE OF THE PROGRAMMED DISTRIBUTION GENERATOR. Samsky, D. N. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1, 1967. Contract AT(45-1)-1830. 19p. Dep. CFSTI.

Operation of the Programmed Distribution Generator (PDG) is described. The PDG consists of an interface, a flexible program, and the PDP-8 analyzing system. (TSS)

39180 (EIR-123) MESSUNG VON TOTALEN WIRKUNGSQUERSCHNITTEN FUER NEUTRONEN ZWISCHEN 0,01 UND 10 eV MIT DEM EIR-FLUGZEITSPEKTROMETER. (Measurement of the Total Interaction Cross Sections for Neutrons between 0,01 and 10 eV Using the EIR Time-of-Flight Spectrometer). Brunner, J.; Widder, F. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). July 1967. 47p. (In German). Dep.

The EIR neutron spectrometer with a 15 m flight path is described. The installation is set up at a beam hole of the reactor DIORIT. The neutron chopper consists of a rotor (K-Monel) with four straight slits and is driven by a hysteresis motor at speeds between 1500 rpm and 24000 rpm. The resolution ranges from 3.9 μs/m and 0.27 μs/m. The neutron bursts produced are used in measuring total cross sections between 0.01 eV and 10 eV by means of the transmission method. Problems associated with energy-dependent background, evaluation of resonance parameters with the aid of suitable computer programs, and error calculations are discussed. Results in the form of $\sigma(E)$ curves and resonance parameters are given for dysprosium, lutetium and iridium. A comparison of these measurements with earlier results shows that the total cross section data was improved in different energy intervals in the thermal region. Several resonance parameters in the same energy range could be improved while some discrepancies in the resonance parameters remain unsolved. (auth)

39181 (EUR-3265.f) ETUDE D'UN INSTRUMENT PORTATIF POUR LA MESURE DE LA CONTAMINATION RADIO-ACTIVE DES ALIMENTS. (Design of a Portable Instrument for Measuring the Radioactive Contamination of Foodstuffs). Boulenger, R. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). June 1967. 84p. (In French). Dep.

The characteristics of a prototype of an apparatus for detecting radioactive contamination in foodstuffs after a nuclear accident, the contamination being assumed to be fairly extensive, are described. A critical analysis of different types of possible accidents and the isotopic composition of the mixtures of radionuclides likely to affect foodstuffs was conducted. Guide levels were then presented for the radioactive contamination of foodstuffs. The apparatus consists of a semiportable transistorized measuring unit and a scintillation probe. The probe is enclosed in a stainless steel leaktight tube, thus facilitating cleaning and decontamination, if necessary. The detector is of high sensitivity, and the measurements are simplified by means of a single-channel system. The experiments carried out have proved the practical utility and efficiency of this instrument. (auth)

39182 (K-DP-2450) FAST-NEUTRON RESPONSE FUNCTION CALCULATIONS FOR POLYETHYLENE-MODERATED FISSION CHAMBERS. Greene, N. M.; Mynatt, F. R. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). [1967]. Contract W-7405-eng-26. 6p. (CONF-671102-5). Dep. CFSTI.

For Presentation at 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

Fast neutron response function calculations for polyethylene-moderated boron carbide fission chamber are presented. A number of spectrally dependent sources striking the detectors at various positions were considered. The calculations corresponded with calibration performed at the ORNL Bulk Shielding Reactor. (B.G.D.)

39183 (LYCEN-67-45) CONTRIBUTION A L'ETUDE DES NIVEAUX EXCITES DU Ni^{61} ET DU Hg^{200} A L'AIDE D'UN DETECTEUR Ge(Li). (Contribution to the Study of Excited Levels of ^{61}Ni and ^{200}Hg by Means of a Ge(Li) Detector). Beraud, Robert (Lyon Univ. (France). Institut de Physique Nucleaire). June 1967. 58p. (In French). Dep.

Thesis.

The characteristics of a Ge(Li) detector were determined with respect to its utilization in spectrometry measurements and in the measurement of angular correlation. The detector was used to study the decay of $^{61}Cu \rightarrow {}^{61}Ni$ and $^{200}Tl \rightarrow {}^{200}Hg$, making it possible to define the level scheme of the end nuclei. The operational principles of Ge(Li) detectors are first reviewed. The energies of fourteen new transitions in the energy levels of ^{61}Ni were deter-

mined with a precision of the order of 1 keV and the intensities of 20 de-excitation γ rays of ^{200}Hg were measured. The results are tabulated. (J.S.R.)

39184 (NP–16758) DISENO DE UN ANALIZADOR DE RADIACIONES IONIZANTES. (Design of Ionizing Radiation Counter). Mendez Duran, Javier (Instituto Politecnico Nacional, Mexico City. Escuela Superior de Ingenieria Mecanica y Electrica). 1965. 126p. (In Spanish). Dep.

Thesis.

The design of a portable scintillation detector that can be operated either on ac current or with batteries was studied. The theory of operation of the instrument and the desired characteristics are discussed. The construction, maintenance, and operation of the scintillation detector are described. (J.S.R.)

39185 (NP–16990) THE DEVELOPMENT AND PERFORMANCE OF A PROTOTYPE SHADOW-SHIELD WHOLE BODY MONITOR. Boddy, Keith (Scottish Research Reactor Centre, East Kilbride (Scotland)). [1966]. 13p. (SRRC–13/66). Dep.

A shadow shield whole body monitor was developed which is capable of high sensitivity at low cost and which is of suitable design for incorporation in a mobile laboratory. The stages of development and the performance of the final prototype are described so that the shielding requirements and crystal volume can be estimated approximately for a required sensitivity. The prototype, using a 3 inches diameter × 3 inches sodium iodide detector, has a sensitivity, or minimum detectable activity for iron-59 and cobalt-58 of approximately 4×10^{-9} μCi. With a detector 11½″ diameter × 4″, it is shown that sensitivities comparable with steel-room monitors can be expected. The variation in counting-rate due to redistribution of the isotope in the patient's body has been examined. It is estimated that the maximum variation is unlikely to exceed ±16 per cent while measurements on patients following oral absorption of iron-59 have shown that the standard error did not exceed ±10 per cent. The cost of a monitor similar to the prototype would be about £2,500 if a single channel analyzer was adequate. For one with sensitivity comparable to a steel room monitor (11½″ × 4″ detector) with a 100 channel analyzer and printer, the cost would be about £6,500. (auth)

39186 (RHEL/S–101) DESIGN STUDY FOR A HIGH MAGNETIC FIELD HYDROGEN BUBBLE CHAMBER FOR USE ON NIMROD. (Rutherford High Energy Lab., Chilton (England)). Jan. 1967. 159p. Dep. UK.

The physics aspects and technical feasibility of a high magnetic field hydrogen bubble chamber for use at NIMROD are discussed. Topics include design specifications, pressure vessel, beam injection, optics, expansion system, vacuum system, superconducting magnets, refrigeration systems, safety, instrumentation and controls, buildings, and economics. (W.H.K.)

39187 (RISÖ–142) INTERPRETATION OF ABSOLUTE MEASUREMENTS OF RADIOACTIVE SOURCE STRENGTH BY THE 4 π BETA–GAMMA–COINCIDENCE METHOD. Thomas, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct. 1966. 85p. Dep.

Absolute measurements of radioactive source strength by the 4 π beta-gamma-coincidence method are interpreted. After a description of the statistical behavior of a generalized multiscaler instrument, the special case of the beta-gamma-coincidence method is evaluated. The theory is demonstrated by the measurement of ^{198}Au in gold foils, where the final accuracy is shown to be between 0.1 and 0.2 per cent. Special attention is given to the count-rate-dependent corrections, which are here measured directly by means of the substitution method. (auth) (DENM)

39188 (RISO–M–534) BERETNING OM ARBEJDET I ELEKTRONIKAFDELINGEN I TIDEN 1 OKTOBER TIL 31 DECEMBER 1966. (Quarterly Report of the Electronics Department for the Period October 1–December 31, 1966). (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar. 1967. 32p. (In Danish and English). Dep.

A progress report is presented on instrumentation. Topics discussed are design of a magnetic drum system for the PDP-8 computer, fuel leakage detection in water reactors, shutdown reactivity measurements, use of computer technique in safety, alarm, and interlock systems, quantitative determination of uranium and thorium using α spectrometry, and automatic curve adjustment in computer. (J.S.R.)

39189 (SFL–A6) THE CONSTRUCTION AND CALIBRATION OF THE WHOLE-BODY COUNTER IN THE INSTITUTE OF RADIATION PHYSICS. Suomela, Matti (Institute of Radiation Physics, Helsinki (Finland)). Mar. 1967. 18p. Dep.

The construction and calibration of a whole-body counter is reported. In the multidetector scanning technique used, the subject lies in the middle of a circular frame on which the holders for four NaI(Tl)-crystal (5″ × 4″) detectors are placed. During a scan measurement, the frame is driven at a constant speed longitudinally to the person, and the scanning time can be adjusted between 3 to 90 min for a 170 cm scan. A special feature of the multichannel analyzer is that a pulse-height spectrum and a multiscalar spectrum of incoming pulses can be registered simultaneously. The multiscaler spectrum, registered during a scan, is used to determine the longitudinal distribution of an isotope in a subject. The variation of the counting efficiencies in the cross section of a phantom and longitudinally along the scanning path are examined. The calibration factors from phantom measurements are 10.7 cpm/nCi for ^{137}Cs and 0.76 cpm/gK for ^{40}K. The spectrometric resolution determined from measurements in vivo is 12% for ^{137}Cs and 9% for ^{40}K photopeak. Typical background counting rates are also given. (auth)

39190 (SLAC–74) STREAMER CHAMBER DEVELOPMENT. Bulos, F.; Odian, A.; Villa, F.; Yount, D. (Stanford Linear Accelerator Center, Calif.). June 1967. Contract AT(04-3)-515. 142p. Dep. CFSTI.

A detailed account is given of the present understanding of streamer chamber technology. This includes streamer theory, various properties and experimental observations relating to streamers, optics, chamber and high voltage technology. A brief comparison of data analysis problems for streamer and bubble chambers is presented. It includes most of the formulae, rules of thumb, recipes, impressions and helpful hints gathered in the course of developing a 2-meter chamber. (B.G.D.)

39191 (SZS–9/67) EIN ROEHRENELEKTROMETER NACH DEM FARMER-PRINZIP ZUM LADEN UND AUSWERTEN VON KONDENSATORKAMMERN. (A Tube Electrometer According to the Farmer Principle for Loading and Evaluation of Condenser Chambers). Steuer, J. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). July 1967. 27p. (In German). Dep.

A vacuum-tube electrometer was designed for loading and measuring condenser ionization chambers according to the principle of Farmer providing a direct reading of the voltage loss. The present design is adaptable to various types of chambers and measuring conditions by the flexibility of its parameters. With a special equipment to avoid disturbances a better short time stability of zero is obtained compared to some types of industrial electrometers. Experiences obtained with the described prototype might be useful for the construction of other electrometers. (auth)

39192 (UCRL–50007-67-1) HAZARDS CONTROL PROGRESS REPORT NO. 27, JANUARY–APRIL 1967. (California Univ., Livermore. Lawrence Radiation Lab.). Contract W-7405-eng-48. 61p. Dep. CFSTI.

The designs and uses of radiation detectors, air samplers, fire and smoke detectors, and respirators for use in hazards control are discussed. (B.G.D.)

39193 (ANL–Trans–509) AUTOMATIC EVALUATION OF NUCLEAR TRACK PLATES AND SOLID DETECTOR PLATES. Bitter, F.; Fiedler, G.; Wollnik, H. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Nucl. Instrum. Methods, 51: 241–4(1967). 9p. Dep. CFSTI, JCL $1.10 fs, $0.80 mf.

An orthogonal mechanical scanner is described which makes the time consuming and tedious tasks of visual scanning of nuclear emulsions and solid detector plates in special cases obsolete. With this instrument in about 120 min a plate of 2.5×7.5 cm^2 can be scanned completely in 10 μm wide stripes with a velocity of 2.8 cm/sec. The advantage of this instrument is the electronic pulse-length discrimination which makes it unnecessary to use several photomultipliers and several channels of discriminators. The handling of the instrument as well as the particle identification thus is very much simplified. The instrument is used to scan the mass spectrum of fission particle tracks in nuclear emulsions as well as in solid detectors. (auth)

39194 EXPERIMENTAL STUDY OF IRREGULARITY IN THERMAL NEUTRON FLUX AT SURFACE OF ABSORBING MATERIAL BY MEANS OF A CALORIMETRIC DEVICE. Karasev, V. S.; Kolyada, V. M. At. Energ. (USSR), 22: 320–1 (Apr. 1967). (In Russian).

An inhomogeneous neutron flux distribution due to such factors as fuel configuration, location of control rods and reflectors, or boundary effects can be determined by measuring the heat evolved in a small cylindrical sample containing a mixture of ^{235}U + C. The sample is surrounded on all sides except one by a layer of cadmium. The thermal neutrons entering the unprotected slit strike the ^{235}U and result in fission heat being liberated in the ^{235}U directly proportional to the neutron flux. The background heat due to neutron and gamma absorption from reactions other than thermal neutron fission is determined experimentally from a sample identical in all respects with the first sample with the exception that the sample is completely covered with a layer of cadmium

metal. The error in determining the neutron flux was 6 to 7% compared to an error of 7 to 10% obtained by estimating the neutron flux from gold foil activation. The ratio of maximum thermal neutron to the minimum was found to be 1.58 on the surface of an absorbing material in a beryllium reflector. A significant advantage of the calorimetric method is the possibility of prolonged and repeated use of the device in the reactor. (TTT)

39195 FISSION CHAMBERS COMPENSATED FOR BURN-UP. Dmitriev, A. B.; Grekov, A. S.; Malyshev, E. K. At. Energ. (USSR), 22: 314-15(Apr. 1967). (In Russian).

Ionization chambers which can operate for a long period of time at high thermal neutron fluxes ($\phi = 10^{15}$ neutrons cm^{-2} sec^{-1}) are necessary for the control of nuclear reactors. The use of the usual mixture of $^{10}B + ^{235}U$ in these chambers is not suitable because of rapid burnup. A mixture of two components can be used in which one component is fissionable, and the other component is not fissionable but can form a fissionable isotope by way of a neutron capture reaction. The suitability of the following four mixtures is investigated: $^{238}U + ^{239}Pu$; $^{238}U + ^{235}U$; $^{232}Th + ^{233}U$; and $^{232}Th + ^{235}U$. A ratio R is selected so that the fission rate at time τ is decreased by not more than 2% as compared with the initial fission rate. The ratio R was determined for these four mixtures at three temperatures of 20, 250, and 500°C and at three integral neutron fluxes of 10^{20}, 10^{21}, and 10^{22} neutrons/cm^2 at a constant neutron flux of 3.2×10^{13} neutrons cm^{-2} sec^{-1}. The $^{233}U + ^{232}Th$ and $^{235}U + ^{232}Th$ mixtures showed the least variation in R with time, but preference was given to the $^{235}U + ^{232}Th$ mixture because of the ready availability of the materials. (TTT)

39196 IONIZATION CHAMBER. Pollermann, M. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik, 9: 210-15(May 1967). (In German).

The physics of ionization chamber operation is discussed in a form applicable to engineering developments and measuring techniques. The amplitude of the signal or the ionization current from the ionization to be measured was derived and the perturbing deviations were represented as functions of the ionization, gas properties, chamber dimensions, and operation voltage. The characteristic line is obtained by which the properties of an ionization chamber can be translated as an electrical measurement probe. (tr-auth)

39197 BEHAVIOR OF FISSION CHAMBER SYSTEM INSIDE THE REACTOR CORE OF THE GARIGLIANO NUCLEAR STATION DURING THE FIRST PERIOD OF OPERATION AT FULL CAPACITY. Foti, Guido. Energ. Elet., 42: 345-50(1965). (In Italian).

Boiling water reactors have a neutron flux distribution inside the core that is rigidly dependent on the operational conditions of the installation. This makes it necessary that the operator have at his disposal continuously all information obtainable on the flux distribution. The measurement system in the Garigliano nuclear power plant is briefly described. The operational experience obtained up to June 1964 is summarized. The behavior of the system during the period from June 1964 to April 1965 at full power was reported in an appendix. (tr-auth)

39198 FR 2 ROTATING-CRYSTAL SPECTROMETER AT KARLSRUHE. Ripfel, H. (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik, 8: 267-72(1966). (In German). (KFK-459).

The characteristics of the rotating crystal spectrometer are outlined with a discussion of the rotating crystal as a monochromator, its energy resolution, and background problems. The construction of the spectrometer, together with that of the electric and electronic devices, is described. A typical time-of-flight spectrum obtained with $ZrH_{1.1}$ at 210°C is shown. (J.S.R.)

39199 SOLID-STATE FISSION CHAMBER. Gourdon, J.; Mitaine, J. (Centre d'Etude Nucleaires, Cadarache, France). Nucl. Appl., 3: 560-2(Sept. 1967).

An improved solid-state fission counter uses a collimated fissile foil to provide better discrimination between alpha particles and fission fragments, reliable calibration, and small size. The chamber is readily disassembled and operates in air. (auth)

39200 DELAYED FLUORESCENCE OF ANTHRACENE AND SOME SUBSTITUTED ANTHRACENES. Parker, C. A.; Joyce, T. A. (Admiralty Materials Lab., Poole, Eng.). Chem. Commun., No. 15, 744-5(1967).

Both monomer and dimer bands were observed in the P-type delayed fluorescence spectrum of 9,10-dimethylanthracene. Results were analogous to those reported for pyrene. As the temperature was reduced, the ratio of the efficiencies of delayed fluorescence of the dimer and monomer passed through a maximum, and then fell to a relatively low value at –100° in ethanol. This may be interpreted in terms of competition between two types of mechanism, in one of which the process of triplet-triplet interaction produces excited dimer and in the other excited monomer. The details of these mechanisms are in dispute. The triplet formation efficiency, and the probability factor for the ultimate formation of an excited singlet from two triplets, were determined, using naphthalene as sensitizer. P-type delayed fluorescence was also observed from dilute ethanolic solutions of 9-methyl-, 9-phenyl-, and 9,10-diphenylanthracenes. Unsubstituted anthracene gave appreciable dimer emission at –75°, but little at +20°. It seems that although substitution of two bulky phenyl groups in the 9,10- positions inhibits the formation of excited dimer, it does not prevent the formation of singlet excited monomer from two triplets. This is taken as evidence that triplet-to-triplet energy transfer can occur over distances greater than required for excited dimer formation. (UK)

39201 THE FILM ANALYSIS CENTER IN THE LABORATORY OF PHYSICS. Salvadori, Paolo. Ann. Ist. Super. Sanita, 2: 753-60(1966). (In Italian).

Because of the importance of photogram analysis in experimental physics, a Film Analysis Center for bubble chambers, diffusion chambers and spark chambers has been operating at the Physics Laboratory of the Istituto Superiore di Sanità for several years. This Center has three scanning tables, of the polar and elliptical type, equipped with film projectors, typewriters, punch-units and digitizers. Many parts of these apparatuses were built at the workshop of the Physics Laboratory and set up by the technicians of the Laboratory. Using the scanning tables described above many measurements were done in the field of high-energy particle physics and, recently, in biophysics, when curves, obtained with the ultracentrifuge technique, were analyzed. The measurement accuracy of the scanning tables was tested, and very good results were obtained. (auth)

39202 SOME EXPERIMENTAL SAMPLING RESULTS FOR REGRESSION ANALYSIS APPLIED TO GAMMA-RAY SPECTROMETER DATA. I. Pasternack, Bernard S.; Liuzzi, Anthony (New York Univ. Medical Center, N. Y.). Biometrics, 23: 11-26(Mar. 1967).

Results are reported of an empirical sampling study designed to evaluate the suitability of a statistical model used in analyzing pulse-height distributions arising from the scintillation counting of radioactive materials. A random set of pulse-height distributions was accumulated by repeated counting of a single prepared mixture of 3 radionuclides. The empirical results were obtained from analyses of these distributions. In addition to a discussion of the radionuclide assay problem, the modified weighted least squares solution, and some actual applications of this method of analysis, the empirical sampling results are presented. The results obtained confirmed the applicability of this method of analysis. Under conditions of model adequacy, the inferred statistical properties of estimates of radionuclide content and the ratio statistic were verified experimentally. Experience indicated that model inadequacies may be frequently caused by gain inconsistencies, and procedures are being developed to account for this type of model inadequacy. These procedures represent nonlinear modifications of the assumed regression model. The empirical sampling approach discussed here will be used to investigate the effects of these modifications on the weighted least squares procedure. (BBB)

39203 GAMMA SPECTROMETRY OF LOW ACTIVITY SAMPLES. Stransky, Pravoslav; Santholzer, Vilem (Charles Univ., Hradec Kralove, Czech). Sb. Ved. Praci Lek. Fak. Karlovy Univ., Hradci Kralove, 9: 698-8(1966).

A comparison of subtractive and graphical methods for determination of activity of a single nuclide in a mixture of γ emitters is presented. A model mixture of ^{137}Cs and ^{54}Mn was counted, the results demonstrating that the graphical method is more precise and quicker for lower activity samples, especially when using a single-channel analyzer. In the subtractive method the activity of the emitter of the higher energy, in this case ^{54}Mn, was determined by comparison of the area of the peak for this nuclide in the mixture and the peak area for the standard. Then the Compton continuum of this nuclide was plotted for the spectrum of the mixture subtracted from it and the activity of the other nuclide could then be determined. In the graphical method, beginning with the highest energy channel, the integral counts were measured for the sample standard, and background for 5 channels at a time and net counts in each of the 5 channels were plotted on logarithmic paper, with the counts of the highest energy standard as abscissa and the counts of the sample as ordinate. By extrapolation of resulting straight line to the lowest channel, the total count for the sample of the highest energy emitter was obtained. The ratio of this count to the count rate of standard is also the ratio of their activities so that the activity of the first nuclide can be determined. By subtracting the contribution of the highest

energy nuclide from the counts in the lower channels (from the counts that are given by points not lying on the line) and by drawing a parallel line, it was possible to determine the activity of lower energy nuclide. (BBB)

39204 QUANTITATIVE ANALYSIS OF GAMMA-RAY SPECTRA BY THE METHOD OF LEAST SQUARES. Stransky, Pravoslav (Karlov Univ., Hradci Kralove, Czech.). Jad. Energ., 13: 92-4(Mar. 1967). (In Czech).

An analysis of gamma-ray scintillation spectra by the method of least squares is presented. There are shown the advantages of this method against the others used for the analysis of the spectra. The method is more rapid and more accurate and a standard deviation of the measurement is calculated. An Autocode program was elaborated for a Polish ODRA 1003 computer and the verification of this method was carried out. The results of the analysis of simulated mixture of $^{54}Mn + ^{137}Cs + ^{106}Rh + ^{144}Ce$ are described. (auth)

39205 ANALOG ELECTRONICS ASSOCIATED WITH SEMICONDUCTOR DETECTORS. Servent, J. M. Instrum. Nucl. (Paris), No. 29, 19-30(May 1967). (In French).

The constitution of a classical measurement ensemble for spectrometry by semiconductor detectors and the essential characteristics that such an ensemble should have are described. The different devices which are in industrial production for semiconductor spectrometry are reviewed. The instrumental studies now being made that show possibilities of industrial applications are reviewed. (J.S.R.)

39206 BETA AND GAMMA SPECTROMETRY USING SEMICONDUCTOR DETECTORS. Legrand, J. (CEN, Saclay, France). Instrum. Nucl. (Paris), No. 29, 31-5(May 1967). (In French).

The use of semiconductor detectors in β and γ spectrometry is outlined. Silicon detectors are used for β spectrometry. The electron conversion spectrum of ^{198}Pt and the β spectrum of ^{14}C are shown as typical examples of the spectra obtainable with semiconductors. For γ spectrometry germanium semiconductors are used. The resolution obtainable with these spectrometers make it possible to separate ^{95}Zr and ^{95}Nb, ^{199}Au and ^{198}Au, and fission products. The primary disadvantages of these detectors are also given. (J.S.R.)

39207 APPLICATION OF SCINTILLATION COUNTERS IN RADIOACTIVE BORE-HOLE SURVEYS. Marhoffer, Jozsef (National Petroleum and Gas Industry Trust, Budapest). Atomtech. Tajek., 10: 373-81(1967). (In Hungarian).

A two-channel scintillation counter was used in logging operations during prospecting for natural gas in the region of Szeged. The instrument allowed simultaneous recording of the natural and the neutron γ intensities at temperatures up to 120°C and pressures of 600 atmospheres. NaI(Tl) crystals of differing size and photomultipliers formed the two channels. The system yielded good results to a depth of 2500 meters; for operations to 3000 m special preparations were required during the drilling. It is planned to use the instrument under conditions, in which the salt content of the drilling mud approaches that of the water table, as in that case its low resolving power prevents the use of the customary G–M counters. The efficiency of the counter was found to depend on the γ energy to be measured. The natural γ radiation of the rocks is usually quite low; in that case the efficiency of the counter is about 70%, but for the relatively high-intensity neutron-induced secondary γ radiation, the efficiency of the counter is reduced to 15 to 18%. (TTT)

39208 DATA HANDLING SYSTEM FOR SONIC SPARK CHAMBERS. Djokic, C.; Dutton, L. M. C.; Howells, R. J. W.; Jafar, J. D.; Van Der Raay, H. B.; Ryan, D. G.; Stiegelmair, J. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods, 55: 80-6(Sept. 1967).

A data handling system for sonic spark chambers using long piezo-electric crystal microphones is described, a multichannel pulse-height analyzer with a 1 μs transfer time was used as the data store. The performance of the system is illustrated by the measurement of the properties of a 1.69 GeV/c scattered proton beam from the Birmingham synchrotron. (auth)

39209 PRACTICAL SOLID-STATE BETA SPECTROMETER. Prevo, C. T.; Cate, J. L. (Univ. of California, Livermore). Contract W-7405-eng-48. Nucl. Instrum. Methods, 55: 173-6(Sept. 1967). (UCRL-70395).

A system for the rapid and routine measurement of unknown beta-ray energies was developed. It uses a cooled lithium-drifted silicon detector, and is accurate to within ±2% for single-component spectra. Descriptions of the electronic and mechanical systems are included, as well as sample spectra. (auth)

39210 CRITERIA FOR SELECTION OF ABSORBER MOUNTING MATERIALS IN MOESSBAUER SPECTROSCOPY. May, L.; Snediker, D. K. (Catholic Univ. of America, Washington, D. C. National Bureau of Standards, Washington, D. C.). Nucl. Instrum. Methods, 55: 183-8(Sept. 1967).

The criteria for the selection of materials for mounting absorbers include their mechanical and chemical properties and their attenuation of the γ-rays and x-rays emitted from the Mössbauer source. Attenuation of the 14.4-keV γ-ray and 6.3-keV x-ray associated with ^{57}Fe was measured for nine commercial materials including plastics and metals. The linear absorption coefficients and half-thicknesses for each material were measured. The usefulness and limitations of each material are discussed, along with three different absorber mounting techniques. (auth)

39211 NEUTRON DETECTION AND DOSIMETRY BY MEANS OF ULTRASONIC CAVITATION IN WATER. De Santis, P.; Sette, D.; Wanderlingh, F. (Univ., Rome. CNR, Rome). Nucl. Instrum. Methods, 55: 189-97(Sept. 1967).

Nuclei for ultrasonic cavitation in liquids may be produced by energetic neutrons. Experiments are described which allow the use of cavitation in water to detect fast neutrons. Moreover by adding suitable substances to water an approximate evaluation of neutron energy can be obtained. (auth)

39212 SINGLE CRYSTAL SLOW NEUTRON SPECTROMETER AT THE PULSED REACTOR IN DUBNA. Gordon, J. (Central Research Inst. for Physics, Budapest); Pellionisz, I.; Vizi, I.; Zsigmond, G.; Szkatula, A. Nucl. Instrum. Methods, 55: 151-6(Sept. 1967).

A spectrometer built for combination of monocrystal and time-of-flight techniques is described. The wavelength resolution is 1.5%, while the time resolution of the spectrometer is 18 μs/m with normal water and 25 μs/m with the polyethylene-beryllium cooled moderator. For the latter the slow neutron flux at the sample is 30 n/cm^2·sec. The background is less than 0.6 n/h for 16 μs channel width on a detector surface of 250 cm^2. As an example of application the distribution curve for critical scattering on iron is presented. (auth)

39213 EXPONENTIAL PULSE RATE GENERATOR. Conradie, H. A. (Atomic Energy Board, Pelindaba, S. Africa). Nucl. Instrum. Methods, 55: 165-9(Sept. 1967).

Two operational amplifiers connected in a positive feedback configuration generate a true, exponentially increasing output voltage. The stability of the circuit is such that time constants of the order of two minutes can be stably generated. This output voltage is subsequently digitized and shaped to form the output pulses. In order to render the instrument more useful, two additional facilities, namely a fixed rate output, adjustable to anywhere between 0–1000 Hz, and a linearly increasing pulse rate range are built into this instrument. (auth)

39214 ARGON–NITROGEN PROPORTIONAL SCINTILLATION COUNTER. Policarpo, A. J. P. L.; Alves, M. A. F.; Conde, C. A. N. (Univ., Coimbra, Portugal). Nucl. Instrum. Methods, 55: 105-19(Sept. 1967).

The characteristics of a gas proportional scintillation counter are studied for various argon-nitrogen mixtures at total pressures of aroung 1000 torr, using α-particles. Measurements of the delay between the primary and the secondary scintillation pulses show that most of the secondary light is produced close to the central anode. The secondary scintillation amplitude increases sharply with the nitrogen concentration reaching a maximum at about 2.5%. Its variation with the anode voltage is studied and it is shown that for large voltages higher order scintillation components appear. The various factors affecting the energy resolution are considered. The experimental resolution is found to be limited by the appearance of the higher order components, the light collection efficiency and the photomultiplier. The extrapolation of the data shows that if the first factor can be eliminated the resolution will be limited by the total number of photons produced and not by a scintillator intrinsic resolution which is found to give a contribution of less than 1%. The spectral analysis of the secondary light (carried out with optical filters) is made for various voltages and nitrogen concentrations. It shows that most of the light is produced within the 3250 Å–3800 Å region. The importance of nitrogen on the secondary scintillation mechanism is discussed. (auth)

39215 SEMICONDUCTOR DETECTOR CRYOSTAT. Miner, C. E. (Univ. of California, Berkeley). Contract W-7405-eng-48. Nucl. Instrum. Methods, 55: 125-37(Sept. 1967). (UCRL-17201).

The mechanical design of a multipurpose cryostat system for nonencapsulated Ge(Li) and Si(Li) semiconductor radiation detectors is described. A standardized system that will accept many styles and sizes of detectors, and that lends itself to many kinds of experiments is presented. (auth)

39216 MATCHING AND BACKING PROBLEMS IN PIEZOELECTRIC READOUT SYSTEMS. Leskovar, B. (Univ. of California, Berkeley). Nucl. Instrum. Methods, 55: 34-54 (Sept. 1967). (UCRL-17434).

The effects of matching and backing on the performance of the piezoelectric ceramic transducers used in delay line readout systems for spark chambers are considered. Analysis and probe design are presented for a nonresonant matching system intended for pulse-strain detection application. Particular emphasis is laid on determination of the input acoustical impedance of an exponential matching connector. The input acoustical impedance is calculated and plotted as a function of the normalized frequency, the specific acoustical impedances ratio between the backing material and the matching connector material, and the ratio of the large end diameter-to-small end diameter of the connector. (auth)

39217 FABRICATION OF THIN NaI(Tl) SCINTILLATION LAYERS FOR LOW ENERGY X-RAY DETECTION. Bauer, R. W.; Weingart, R. C. (Univ. of California, Livermore). Contract W-7405-eng-48. Nucl. Instrum. Methods, 55: 55-60(Sept. 1967). (UCRL-70423).

The preparation and performance of thin homogeneous NaI(Tl) scintillation layers with large surface areas are described. Scintillators with thicknesses ranging from 0.2 to 20 mg/cm^2 and a circular surface area up to 5 cm^2 were produced by vacuum deposition. The scintillation efficiency and uniformity of light output of the layers was investigated with 6- and 22-keV radiation and found to be comparable with commercially available, thicker NaI(Tl) scintillators. (auth)

39218 CRITERIA FOR EVALUATING BACKGROUND SUPPRESSION TECHNIQUES IN NUCLEAR SPECTROSCOPY BASED ON CONSIDERATION OF STATISTICAL ACCURACY. Galloway, R. B. (Univ., of Edinburgh). Nucl. Instrum. Methods, 55: 29-33(Sept. 1967).

A discussion is presented of the improvement possible in the statistical accuracy with which the intensity of a peak may be determined by improvement of the peak to background ratio when associated with a reduction in detection efficiency. (auth)

39219 ELASTIC SCATTERING EMPLOYING NUCLEAR EMULSION AS DETECTOR. Khan, Abdul Hannan (Atomic Energy Centre, Dacca, Pakistan); Hossin, Anwar; Sen Gupta, Hiranmoy. Nucl. Sci. Appl., 2: No. 2, 6-12(Oct. 1966).

Development of the technique of nuclear emulsion as detector is described and gradual improvement of cameras including the one constructed at Dacca for both gaseous and solid targets is given. Some of the results obtained are also mentioned. (auth)

39220 SUM-COINCIDENCE SPECTROMETER AND ITS CHARACTERISTICS. Hossain, Muhtasham (Univ. of Dacca, Pakistan); Ahmed, Nehaluddin; Khaliquzzaman, Md. Nucl. Sci. Appl., 2: No. 2, 1-5(Oct. 1966).

The facilities afforded by a sum coincidence spectrometer in simplifying the gamma ray spectra observed in a single NaI(Tl) crystal from the decay of excited nuclei and in improving the resolution are discussed. A spectrometer is described which uses commercial equipment along with a sum-coincidence unit built in the laboratory. The single spectra for ^{60}Co are presented and different characteristics of the spectrometer are shown. (auth)

39221 PRESENT STATE OF THE INDUSTRIAL FABRICATION OF SEMICONDUCTOR DETECTORS. Fertin, J. Instrum. Nucl. (Paris), No. 29, 14-18(May 1967). (In French).

The present state of the industrial fabrication of semiconductors is discussed according to the techniques used. The manufacture of detectors using diffusion and surface barrier techniques use well-known physical procedures and fabrication technologies. However, the production of Li-compensated Si and Ge crystals has many problems of a mechanical nature because these detectors undergo cycles of varied and severe treatment in usage. Three possible solutions for the realization of these crystals are illustrated. (J.S.R.)

39222 SEMICONDUCTOR DETECTORS: EVOLUTION, PERFORMANCES, FUTURE PROSPECTS. Coche, A. (Faculte des Sciences, Strasbourg). Instrum. Nucl. (Paris), No. 29, 5-13(May 1967). (In French).

The evolution of the various types of semiconductor detectors and the performances attained with each are briefly reviewed. The various problems posed by the realization and utilization of semiconductor detectors are discussed. The development of heavy particle detectors using surface-barrier detectors with n-p junctions is described and their characteristics are outlined. The problems in perfection of Li-compensated Ge γ detectors are summarized. The resolution, Fano factor, detection efficiency, and forms of pulses and fluctuations of these detectors are discussed. The search for new materials to be used in semiconductor detectors is reviewed. (J.S.R.)

39223 THEORETICAL ANALYSIS OF TIME RESOLUTION IN SCINTILLATION DETECTORS. Sigfridsson, B. (Research Inst. of National Defense, Stockholm). Nucl. Instrum. Methods, 54: 13-28(Sept. 1967).

It is shown that results consistent with experiment are obtained if one assumes an exponential average rate of rise of the single electron response function for the photo-multiplier system (i.e., a nonfixed zero point of time). Furthermore it is shown that a minimum in the time resolution is obtained when the ratio between the number (v) of photo-electrons emitted before the instant of measurement and the total number of created photo-electrons (R) is about equal to the ratio between the rate of decay (λ_2) and the rate of rise (λ_1) of the single electron response function. The optimum resolving time for a single counter is then approximately equal to $2.35[\frac{1}{2}(\lambda_1\lambda_2 R)^{-1}]^{\frac{1}{2}}$. The factor 2.35 originates from the ratio between the full width at half maximum of the resolution curve and the square root of the corresponding variance. In addition it is shown that the time resolution curve does not stop walking as function of R unless v/R is kept constant. For small v/R the displacement of the resolution curve is proportional to $|\log(v/R)|$. Finally, a simple general expression for the time-resolution is derived in which the experimentally measured single electron response function can be inserted giving a very good measure of the time resolution for any scintillation detector. (auth)

39224 NONUNIFORM LUMINESCENCE BY LARGE SCINTILLATORS WITH VARIOUS LIGHT CONDUCTORS. Tonapetyan, S. G.; Konovalov, O. G.; Dorofeev, M. T.; Zybalov, A. A. (Physical-Technical Inst., Kharkov). Prib. Tekh. Eksp., No. 2, 204-5(Mar.-Apr. 1967). (In Russian).

Non-uniform luminescence measurements of 200 × 200 × 6 and 200 × 200 × 15 mm^3 plastic scintillators showed that their luminescence varied 50 and 25% respectively. Comparative studies were made of the light conduction of the two types of light pipes. (tr-auth)

39225 OPTIMUM FILTERS FOR MEASUREMENT OF NUCLEAR PULSES IN THE PRESENCE OF NOISE. Nygaard, K. (Aktiebologet Atomenergi, Studsvik, Sweden). Nucl. Instrum. Methods, 54: 98-104(Sept. 1967).

A theory of the pulse forming circuits for nuclear pulse amplifiers is developed and the optimum filters are described both for pulse height and pulse time (coincidence) measurements. The measured mean error of pulse height measurements carried out by means of the filters described is considerably less than the effective noise voltage. Corresponding results were obtained with the timing filters. The filters are described by means of the amplifier output pulse shape and noise power frequency spectrum and they are easily constructed in practice. In general 10% accuracy in their components is sufficient and they are very insensitive to deviations from the pulse shape and noise power frequency spectrum they were originally designed for. (auth)

39226 STUDY OF SCINTILLATION SPECTROMETRY: UNFOLDING METHODS. Su, Y. S. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Instrum. Methods, 54: 109-15(Sept. 1967).

Analysis and comparison of the inverse matrix method, Scofield's iteration method and the least-squares method are made by utilizing an ideal measurement of an assumed spectrum. It is found that Scofield's method is, in general, a fairly good method while the simple least-squares method can only be used for a small number of energy intervals. Some new approaches to use integral quantities instead of differential quantities in the response relation and to assume a polynomial approximation for the integral responses and the spectrum are proposed for further study, in order to get better interpolation and to use polyenergetic sources as well as monoenergetic sources for constructing the response relation. A modified technique for Scofield's iteration is also presented for faster convergence. (auth)

39227 MATHEMATICAL SMOOTHING OF GAMMA RAY SPECTRA. Yule, H. P. (Texas A and M Univ., College Station). Nucl. Instrum. Methods, 54: 61-5(Sept. 1967).

Gamma ray spectra observed with NaI(Tl) or Ge(Li) spectrometers often exhibit considerable scatter from channel to channel. Mathematical smoothing is capable of removing most of this scatter. Studies of various methods of application of the data convolution technique are described. One method is shown to work quite well. Benefits of using smoothed spectra in further data analysis are discussed. (auth)

39228 SPARK CHAMBER-COMPUTER SYSTEM FOR MEASUREMENT OF PROTON POLARIZATION. Barney, J. (Univ. of

Wisconsin, Madison); Kloeppel, P.; Limon, P.; Olsen, S.; Pondrom, L.; Handler, R.; Wright, S. C. Contracts AT(11-1)-881; NONR-2121(25). Nucl. Instrum. Methods, 54: 66-70(Sept. 1967). (COO-881-84).

A system was developed to analyze proton polarization in the energy range 200 to 400 MeV. It utilizes the readout from magnetostrictive delay lines on wire spark chambers and an on-line computer. At 200 MeV, the average analyzing power using 5 cm of carbon as scattering material is 0.51 ± 0.04. (auth)

39229 LOW PRESSURE SPARK CHAMBERS: HIGH RESOLUTION SPECTROMETER FOR 1 GeV PROTONS. Sutter, R. J. (Brookhaven National Lab., Upton, N. Y.); Bennett, G.; Fischer, J.; Friedes, J. L.; Palevsky, H.; Persson, R.; Igo, G. J.; Simpson, W. D. Nucl. Instrum. Methods, 54: 71-6(Sept. 1967). (BNL-11350).

A low pressure magnetic spectrometer for 1 GeV protons utilizing wire spark chambers operated at 0.1 normal atmosphere is described. The reduced multiple scattering of this system produced a distinct improvement in energy resolution over that of a comparable spectrometer operated at normal atmospheric pressure. Details on the operating characteristics of the low pressure spark chambers are given, and an outline of the pressure regulating system is included. (auth)

39230 LOW INPUT-IMPEDANCE PREAMPLIFIER FOR SEMICONDUCTOR DETECTORS. Nishihara, H.; Takeda, S. (Kyoto Univ.). Nucl. Instrum. Methods, 54: 42-56(Sept. 1967). (In German).

A new low input-impedance preamplifier for semiconductor detectors was developed. The input-impedance is 92 Ω to match with the characteristic impedance of the coaxial cable RG-62U. This preamplifier supplies both a fast current-pulse with a rise-time of 8.1 ns (current-amplifier) and a charge-pulse with a decay-time of 3 μs (charge-amplifier). The charge-pulse is obtained by integrating a fast current-pulse and by extending the pulse decay-time with a built-in pulse stretcher. The gain of the current- or the charge-amplifier is equivalent to 11 kΩ or 0.195 pF respectively. The amplitude of the output-pulse is almost independent on the distance (cable length) between the detector and the preamplifier. The rms noise amplitude is 26 nA for the current-amplifier and 22.6×10^{-17} C for the charge-amplifier. (auth)

39231 POSITION SENSITIVE GEIGER COUNTER. McDicken, W. N. (Univ. of Glasgow). Nucl. Instrum. Methods, 54: 157-8 (Sept. 1967).

A position sensitive Geiger counter was developed using the technique of current division on a resistive wire anode. The counter is 70 cm long and has an average resolution of 2 cm. (auth)

39232 THRESHOLD ELECTRIC FIELDS FOR MICROWAVE SPARK CHAMBERS. Doviak, R. J.; Moezzi, A.; Goldhirsh, J.; Lombardini, P. P. (Univ. of Pennsylvania, Philadelphia). Nucl. Instrum. Methods, 54: 161-2(Sept. 1967).

A theoretical formulation which is supported by an experimental program, giving the electric field threshold necessary to produce minimum perceptible tracks in microwave spark chambers containing neon-argon mixtures, is described. This formulation gives an electric field threshold which is within 10% of experimental results. (auth)

39233 $4\pi\gamma$-IONIZATION CHAMBER FOR MEASUREMENT OF LOW ENERGY GAMMA-EMITTERS. Erdelyvari, I.; Feher, I. (Central Research Inst. for Physics, Budapest). Nucl. Instrum. Methods, 54: 163-4(Sept. 1967).

A 2.5 l volume $4\pi\gamma$-ionization chamber was developed for the rapid determination of ^{125}I activity in the range from 10 μCi to 0.1 Ci. (auth)

39234 WIDE-GAP SPARK CHAMBER FILLED WITH NEON AND ETHANOL OR WATER VAPORS. Kotenko, L. P.; Merzon, G. I.; Vinogradov, A. D.; Vlasov, N. G. (Lebedev Inst. of Physics, Moscow). Nucl. Instrum. Methods, 54: 119-24(Sept. 1967).

Influence of ethanol and water additions into a wide gap spark chamber on dispersion and width of the tracks was studied for long time delays of high voltage pulses (τ_d = 2.8–50 μs). The mean square scattering of tracks in the spark chamber filled with Ne + C_2H_5OH was shown to be approximately five times less than in the spark chamber filled with pure neon regardless of time delay. The quality of tracks in a spark chamber filled with Ne + H_2O is to some extent worse than in the case of Ne + C_2H_5OH but considerably better than with pure neon filling. The explanation of observed effects is given. (auth)

39235 CSUP, A COMPUTER PROGRAM TO RECONSTRUCT A PHYSICAL DISTRIBUTION, FROM COUNTING SPECTRA DISTORTED BY THE INSTRUMENTAL RESOLUTION. Dotti, D. (CISE, Milan). Nucl. Instrum. Methods, 54: 125-31(Sept. 1967).

In nuclear physics experiments the counting spectra obtained from a measuring chain are often strongly distorted by the finite instrumental resolution. A computer aided method (CSUP) is described which furnishes the most probable input spectrum and its uncertainty from the knowledge of both experimental spectrum and instrumental resolution, by means of an averaging process performed on all the possible input configurations. The effectiveness of the proposed method is stressed by a comparison with the least-squares method, and by the application to two cases of particular interest in nuclear physics experiments. (auth)

39236 SELECTION OF SPARK CHAMBER TRACKS BY COMPUTER METHODS. Duff, B. G. (University Coll., London); Garbutt, D. A.; Rosner, R. A.; Walker, R. N. F. Nucl. Instrum. Methods, 54: 132-6(Sept. 1967).

Four methods are described for the selection of straight, curved and intersecting spark-chamber tracks from background by computer program. A comparison of their speeds and efficiency is made as a result of performance on an IBM 7090 computer using sample configurations in a 20-gap spark chamber. (auth)

39237 SELECTION OF GERMANIUM LITHIUM DRIFT DETECTORS FOR GAMMA RAY SPECTROSCOPY. McKenzie, J. M. (Bell Telephone Labs., Inc., Murray Hill, N. J.); Donovan, P. F.; Gynn, A. C. Nucl. Instrum. Methods, 54: 147-9(Sept. 1967).

A few very high resolution large germanium lithium drift detectors have been reported (<4 keV ^{60}Co, >20 cm^3). The resolution of the large detectors currently available, however, is much poorer than these exceptional units. Smaller detectors with high resolution are much more easily obtainable. Thus in most gamma ray spectroscopy it is necessary to compromise between the size and the resolution of the available detectors. (auth)

39238 ROTATING GAS CELL FOR CHARGED PARTICLE WORK. Zurmuhle, R. W.; Fou, C. M. (Univ. of Pennsylvania, Philadelphia). Nucl. Instrum. Methods, 54: 151-2(Sept. 1967).

This gas cell was designed particularly for the measurement of angular distributions of charged particles with solid state detectors. (auth)

39239 ACCURATE STATISTICAL MEASUREMENT OF SCINTILLATION SPECTROMETER RESOLVING POWER. Tsirlin, Yu. A.; Ekkerman, V. M. (All-Union Scientific-Research Inst. of Monocrystals, Kharkov). Prib. Tekh. Eksp., No. 2, 49-51(Mar.-Apr. 1967). (In Russian).

The simultaneous effects of statistical fluctuations in the rate of calculation and of the maximum width of the analyzer channel on the accurate determination of a gamma spectrometer resolution are discussed. The number of pulses in the maximum peak of total absorption as a function of resolution was studied in order to secure precise measuring data. (tr-auth)

39240 EFFECTS OF LIGHT CONDUCTOR ON γ-SPECTROMETER CHARACTERISTICS. Lashuk, A. I.; Sadokhin, I. P. Prib. Tekh. Eksp., No. 2, 51-3(Mar.-Apr. 1967). (In Russian).

The influence of various conical plexiglass light pipes on the resolution and the number of pulses in the maximum absorption peaks was studied using NaI(Tl) crystals. The conical plexiglass light pipes had a 100 mm base and were 12, 22, 27, and 34 mm high. Radioactive sources were used for calibrating γ spectrometers and studying effects of the light pipe thickness on the spectrometer characteristics. The optimum γ spectrometer resolution was found with light conductor thickness 10 to 13 mm and a light reflector of magnesium oxide coated on the light conductor surface. (R.V.J.)

39241 HIGH-SPEED MOESSBAUER SPECTROMETER. Aleshin, K. P.; Lukashevich, I. I.; Sklyarevskii, V. V.; Stepanov, E. P.; Filippov, N. I. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 2, 53-6(Mar.-Apr. 1967). (In Russian).

Descriptions are given of the design and performance of a Moessbauer spectrometer with a vibrator operating at constant rate up to 30 cm/sec. The spectrometer characteristics were studied using Moessbauer spectra of ^{57}Fe in Fe_2O_3, and ^{161}Dy in gadolinium. The resonance absorption spectra of ^{161}Dy γ rays at 26 keV energy are analyzed. (R.V.J.)

39242 CHARACTERISTICS OF SPARK CHAMBER WITH RUBBER PACKING. Tonapetyan, S. G.; Konovalov, O. G.; Dorofeev, M. T.; Zybalov, A. A. (Physical-Technical Inst., Kharkov). Prib. Tekh. Eksp., No. 2, 61-3(Mar.-Apr. 1967). (In Russian).

Experiments with spark chamber with 36 rubber packed gaps showed that the efficiency of chamber operating with helium was about 85 to 90% per gap. The minimum memory time of the helium-filled chamber was 0.55 μsec. The chamber operates efficiently with gas pressure to 300 torr. The rubber packed

helium-filled counter plateau begins with 10 kV and is 7 to 8 kV. (R.V.J.)

39243 MICROPHONES FOR RECORDING SEVERAL PARTICLES IN THE ACOUSTIC SPARK CHAMBER. Gorodinskii, G. M.; Damaskinskii, E. A.; Konstantinova, M. P.; Kruglov, E. M.; Mokrovskii, N. P.; Romanov, A. M. (Physical-Technical Inst., Leningrad). Prib. Tekh. Eksp., No. 2, 64-7(Mar.-Apr. 1967). (In Russian).

Piezo ceramic and capacitor microphones were developed for recording coordinates of several particles in an acoustic spark chamber and for studying their characteristics. It is shown that in both types of microphones the relaxation time is 3 to 4 μsec; the front signal ~1 μsec, and the ratio of the effective signal amplitude to the noise amplitude exceeds 10. Such microphones are capable of determining the coordinates of several sparks appearing simultaneously in the spark gap. The order of error is ±0.3 mm. The microphones record separately the signal of two sparks passing in the air with the interval of 4 μsec. (tr-auth)

39244 SPARK CHAMBER DISCHARGER CONTROLLED BY LOW AMPLITUDE PULSES. Gorodinskii, G. M.; Damaskinskii, E. A.; Denisov, A. S.; Konstantinova, M. P.; Kruglov, E. M.; Kruglov, S. P.; Mokrovskii, N. P. (Physical-Technical Inst., Leningrad). Prib. Tekh. Eksp., No. 2, 68-70(Mar.-Apr. 1967). (In Russian).

Descriptions are given of the design and performance of a trielectrode discharger with ignition pulses ≥500 V and with operational voltage from 8 to 25 kV. The discharger breakdown delay is less than 50 nsec. The high-voltage pulse front at 50 ohm load is less than 10 nsec. Maximum discharge current is ~10 kA. The discharger endures more than 1×10^6 breakdowns. (tr-auth)

39245 ELECTROPHOTOGRAPHIC DEVICE FOR DETERMINING COORDINATES OF PARTICLE TRACKS IN A SPARK CHAMBER. Biryukov, V. A.; Gromova, I. I.; Pisarev, A. F. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 2, 73-6(Mar.-Apr. 1967). (In Russian).

A simple system was designed for recording data on particle tracks formed in multilayer spark chambers. The system is based on the electrophotographic effect of selenium and selenium–tellurium layers. It is shown that the measuring static probe and rotating cylinder with charged electrophotographic layer are capable of measuring spark coordinates in the chamber with the order of accuracy of 3×10^{-3} m. (tr-auth)

39246 SEMIAUTOMATIC MICROSCOPE MIE-1 FOR MEASURING IONIZATION PARAMETERS OF PARTICLE TRACKS IN NUCLEAR PHOTOEMULSIONS. Lepekhin, F. G.; Raguzin, R. M.; Rakitin, V. M.; Fedorova, N. M. (Leningrad Optical-Mechanical Society). Prib. Tekh. Eksp., No. 2, 77-81(Mar.-Apr. 1967). (In Russian).

A semiautomatic device consisting of a microscope and control panel designed for measuring and recording ionization parameters of particle tracks in nuclear emulsions is described. The device is capable of determining, for singly charged particles, the number and the length of gaps for the total length of the track or for a unit of length and gap range; for multicharged particles, the track area per 10 μ length and the width of the track. The table shift can be continuous or spaced. The measurements of particle parameters for singly charged particles are recorded on a ribbon of a digital machine and the parameters of multicharged particles on a ribbon of an automatic device EPP-09 in relative units. (tr-auth)

39247 SCINTILLATION DECAY TIME IN SCINTILLATION COUNTER. Yakushin, V. V. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 2, 84-9(Mar.-Apr. 1967). (In Russian).

The scintillation decay time of a cone-shaped scintillation detector was determined. The efficiency and resolution of the scintillation detector was determined as a function of sensitive volume and the composition of the scintillator. (tr-auth)

39248 A XENON FILLED SCINTILLATION DETECTOR WITH MULTI-LAYER TARGET FOR STUDYING RARE (n,α) TYPE REACTIONS. Kvitek, I.; Popov, Yu. P.; Rodionov, K. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 2, 90-4(Mar.-Apr. 1967). (In Russian).

Descriptions are given of a four photomultiplier FEU-49, Xenon-filled charged-particle scintillation spectrometer with a multilayer target. The sensitive area of the detector is 0.7 m^2. By dividing the detector into two sections it was possible to measure simultaneously the effect and the background. The efficiency for recording γ quanta was $\lesssim 10^{-3}$ at $\lesssim 10^8$ γ quanta/sec. The detector was capable of measuring the Sm(n,α) reaction with resonance neutrons and obtained the Γ_α magnitudes for 14 resonances. (tr-auth)

39249 TWO-PARTICLE RECORDING EFFICIENCY OF ARGON–ACETYLENE FILLED SPARK CHAMBER. Kiselev, Yu. T.; Terekhov, Yu. V.; Ushakov, V. I. Prib. Tekh. Eksp., No. 2, 207-8(Mar.-Apr. 1967). (In Russian).

The two-particle recording efficiency of an 8 gap spark chamber filled with a mixture of Ar + 0.4% acetylene was measured. The picture of two particles passing simultaneously through the chamber through the chamber and 400 pictures of showers with two and more particles showed that the two-particle recording efficiency was 88 ± 2%, three particles 65 ± 5%, and four particles ~50%. Calculations of the efficiency were made for two spark gaps. The sparks in the rest of the six gaps indicated the passage of particles. Thus, with recordings from the rest of the six gaps the recording efficiency should be high. (R.V.J.)

39250 RECORDER WITH DIRECT DATA SELECTION FOR WIRE-SPARK CHAMBERS. Grachev, A. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 2, 208-10(Mar.-Apr. 1967). (In Russian).

A design is given of a recorder with a direct selection of programmed data for wire spark chambers. The recorder consists of semiconducting elements operating with the pulse duration of ~0.7 μsec and is quite accurate. (tr-auth)

39251 MULTI-LAYER γ-RAY SCINTILLATION SPECTROMETER. Popov, Yu. P.; Stempinskii, M. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 2, 94-7(Mar.-Apr. 1967). (In Russian).

Descriptions are given of the design and performance of a scintillation gamma spectrometer with recording efficiency proportional to the gamma energy. In contrast to the similar single-layer Moxon-Rae detector, the described detector has a transparent multilayer radiation with about five times higher efficiency for neutron capture recording (~20%). (tr-auth)

39252 ANISOTROPY OF STILBENE SCINTILLATION PROPERTIES AND ITS USES IN DEVELOPING DIRECTED NEUTRON DETECTORS. Oparin, E. M.; Saukov, A. I. Prib. Tekh. Eksp., No. 2, 98-100(Mar.-Apr. 1967). (In Russian).

The amplitude distribution of pulses produced in stilbene crystals by 14-MeV neutrons was measured in relation to the angle of crystal deflection. The maximum pulse amplitude variation was 13%. Stilbene properties as a directed neutron detector were analyzed and compared to the properties of a laminated direct neutron detector of special construction. (tr-auth)

39253 MULTIFILAMENT PROPORTIONAL COUNTER FOR SELECTING STOPPED PARTICLES IN A THIN GAS TARGET. Kulyukin, M. M.; Pontekorbo, D. B.; Falomkin, I. V.; Khazins, D. M.; Shcherbakov, Yu. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 2, 101-4(Mar.-Apr. 1967). (In Russian).

The construction and specifications of a proportional counter with multianode structure working with charged particle beams are described. The counter is capable of selecting stopped particles in gas targets (≥ several mg/cm^2). The properties of the counter filled with a He–Ne mixture with various admixtures are discussed. The amplitude of pulses from slow mesons was found within the limits from 1 to 20 mV depending on the concentration of admixtures. Counter gas amplification coefficient did not diminish with γ-source loading equivalent to the loading from meson flux with 10^5 sec^{-1} pulse intensity. The pulse duration was ~1 μsec. The pulse amplitude straggling for α particle calibration (at ~300 keV energy) was 8%. (tr-auth)

39254 MEASURING DEVICE FOR ULTRA MICROSCOPIC QUANTITIES OF RADIOACTIVE ^{37}Ar. Barabanov, I. R.; Veshnikov, V. B.; Pomanskii, A. A. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 2, 109-12(Mar.-Apr. 1967). (In Russian).

A design is given of a device for measuring rare decays of ^{37}Ar. The device consists of a miniature proportional front window counter for calibrating the performance of the device and an automatic Topler pump for pumping the radioactive specimen into the counter. The device is also equipped with an anticoincidence detector, iron shielding for protection against external γ radiation, and circuitry for pulse amplification and discrimination and automatic recording on N-370. (tr-auth)

39255 HIGH-SPEED PRINTING UNIT FOR DELIVERY OF DATA FROM MULTICHANNEL MEASURING SYSTEMS. Vladimirov, V. A.; Zamrii, V. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 2, 117-22(Mar.-Apr. 1967). (In Russian).

A printing unit intended for concurrent operation with neutron spectrometer systems as a general output unit is described. The unit accepts 16-bit binary or binary-coded decimal numbers with logic levels equivalent to 0 (represented by voltages between –4 and –15 V) and a logical 1 (for voltage levels between +10 and +1 V). It has a continuous line feed printer which can print up to

1200 lines/min. Each line contains 16 character spaces for decimal numbers and plus and minus signs. Printing cycle for each line requires 16 msec for setup and 34 msec for actual printing. During setup time two coded numbers are delivered from the spectrometer system, written in registers, converted to appropriate code, and stored in another register while the ratchet drive simultaneously advances the printing paper by one line (5.5 mm). Printing is done by electromechanical means. During the normal automatic mode, the printing unit may deliver 40 numbers/sec. The printing operation may be stopped by a stop signal or automatically after a predetermined number of characters have been printed. Other printing modes are possible, such as asynchronous number-by-number printing or printing controlled via special coded signals. Error-checking features are included. This printing unit may be used in other systems which have compatible output codes. (ATD)

39256 THE FREE AIR IONIZATION CHAMBER OF THE ISTITUTO SUPERIORE DI SANITA. Missoni, Guido; Pugliani, Lucio (Istituto Superiore di Sanita, Rome). Ann. Ist. Super. Sanita, 2: 731-52(1966). (In Italian).

A free air chamber, intended to be a primary standard for the measurement of the exposure to x rays, has been designed and built at the Physics Laboratory of the Istituto Superiore di Sanità. All the procedures adopted to carry out a precise measurement with this instrument are reported. The characteristics of the x-ray beam, such as the H.V.L. in copper and the homogeneity coefficient, and the intensity distribution in the beam were measured. The exposure-distance relation was verified and all the correcting factors relating to absorption, temperature and humidity changes, saturation and field distortions were determined. The capacity of the condensers where the ionization is collected was measured and a check of the performance of the circuit used to measure the tension at which they get charged was carried out. Finally an expression of the exposure in terms of all the measured parameters is given. (auth)

39257 CALIBRATION OF A G–M DETECTOR TO MEASURE ^{85}Kr IN AIR BY IMMERSION IN A STANDARDIZED ^{204}Tl SOLUTION. Davis, M. A.; Shapiro, J. (Harvard Univ., Boston). Health Phys., 13: 907-10(Aug. 1967).

The most direct method of calibrating the detector is to expose it to a known concentration of radioactive gas in a volume which is essentially infinite with respect to β-ray detection. A possible alternate approach would be to immerse the detector in a liquid medium containing a known concentration of beta-emitting isotope of approximately the same energy as the gaseous isotope. The response of the detector, with corrections for energy differences between the two sources, and for the difference in mass absorption coefficients between the water and air media, should give a calibration factor for determining the concentration of the beta emitter in air. In general, calibration with liquid sources is much simpler than with gases. The dimensions of the volumes used are of the order of the range of the β-particles in the medium, and these ranges are only a few millimeters in liquids compared to a meter or so in gases. Transfer operations involving liquids are simpler and more accurate, with less chance of losses, and standardization of liquids can be accomplished with much simpler counting techniques than for gases. The results of a study comparing the calibration of a thin-walled cylindrical GM tube for radioactive gases with gaseous and liquid standard sources are presented. The radioactive gas of interest was ^{85}Kr and the radioactive liquid for standardization was an aqueous solution containing ^{204}Tl as thallium nitrate. (auth) (UK)

39258 YONSEI II BETA-RAY SPECTROMETER AND THE MEASURED BETA-RAY ENERGY SPECTRUM OF ^{137}Cs. Ahn, Se-hee; Chung, Won-mo; Song, Hee-il (Yonsei Univ., Seoul). New Phys. (Korea), 7: No. 1, 13-18(June 1967).

The design and construction of the Yonsei II beta-ray spectrometer of the double-focusing type with a deflection angle of 210° and outer diameter of 120 cm is discussed. This spectrometer has the characteristic of being able to measure e–γ and e–e angular correlations. By using this spectrometer, the beta-ray energy spectrum and energies of internal conversion electrons of Cs-137 were measured. And it was determined that the energy resolution of this spectrometer is approximately 1.0 percent. (auth)

39259 LABORATORY SOURCES ENHANCED IN 0.5 eV TO 200 keV NEUTRONS FOR INSTRUMENT EVALUATION. Block, S.; Bryan, J.; Prevo, C.; Montan, D. (Univ. of California, Livermore). Health Phys., 13: 1025-31(Sept. 1967).

$^{238}PuBe$ or SbBe neutron sources in D_2O moderators can provide a spectrum of neutrons useful for checking the dose equivalent sensitivity of neutron detectors 0.5-eV to 200-keV neutrons. In the calculations, unmoderated $^{238}PuBe$ and SbBe are used as point sources in the center of D_2O spheres. The spectral distribution of the escape neutrons is calculated with a Monte Carlo neutron transport code and is tabulated, together with the dose equivalent rate per unit flux density, for each energy group in the code. Results indicate that intermediate-energy neutrons can be made to contribute up to 74% of the dose equivalent rate of the incident flux density. (auth)

39260 HIGH RESOLUTION NUCLEAR STRUCTURE STUDIES USING 1 GeV PROTONS. Friedes, J. L. (Brookhaven National Lab., Upton, N. Y.); Sutter, R.; Palevsky, H.; Bennett, G.; Igo, G.; Simpson, W. D.; Stearns, R. L.; Corley, D. M. Nucl. Instrum. Methods, 54: 1-12(Sept. 1967). (BNL-11241).

The experimental apparatus used to perform nuclear reaction experiments with 1 GeV incident protons is described. The main element of the system is a magnetic spectrometer which uses digital wire spark chambers and has an energy resolution of 3 MeV fwhm. An on-line computer system, which presents the experimenter with an instantaneous scope display of the data being recorded, is indispensable to this experimental technique. The results of 1 GeV proton-proton scattering are presented to demonstrate the performance of the equipment. (auth)

39261 MEANS FOR DETECTING RADIOACTIVE RADIATION. Chameroy, Jean (to Groupement Atomique Alsacienne Atlantique). British Patent 1,080,707. Aug. 23, 1967. Priority date Nov. 9, 1963, France.

An ionization chamber is designed which operates under high-voltage alternating current. The ionization chamber can be used for measuring gamma neutron flux. The chamber is also suitable for use in reactor safety systems, and particularly in applications which call for gas circulation chambers. (L.B.S.)

39262 A METHOD OF MEASURING PHYSICAL PROPERTIES OF GAMMA- OR X-RAYS, ITS USE AND APPARATUS FOR PERFORMING THE SAME. (to Osterreichische Studiengesellschaft Fur Atomenergie GmbH). British Patent 1,079,153. Aug. 16, 1967. Priority date Nov. 13, 1963, Austria.

A method is described for measuring the physical properties, especially the energy and intensity, of gamma or x radiation, using a lithium-drifted silicon detector, secondary detectors, and multichannel analyzer system. The method and apparatus is proposed for nondestructive measurement of the state of depletion of nuclear fuels. (L.B.S.)

39263 RADIATION MONITOR WITH BACKGROUND COMPENSATION. Smith, Kent F.; Thompson, Jack B. (to U. S. Atomic Energy Commission). U. S. Patent 3,344,277. Sept. 26, 1967.

A device is described for detecting the radiation contamination of a sample in the presence of a widely varying background radiation. The device consists of a GM tube, a linear count rate circuit and a nonlinear count rate circuit producing a signal directly proportional to the output of the GM tube and a signal proportional to the square root of the output of the GM tube, respectively, a filter circuit for filtering out the steady-state value of the linear count rate circuit, and an alarm circuit differentially combining the output of the filter circuit and the nonlinear count rate circuit, whereby the alarm circuit is only activated in response to abrupt changes in the sensed radiation level. (AEC)

39264 HALOGEN COUNTING TUBES. Matauschek, Klaus (to VEB Vakutronik). British Patent 1,074,497. July 5, 1967. Filed Oct. 28, 1964.

A halogen counting tube was developed having a cathode in the form of a layer which is engaged by a cathode contact, the surface of which forms a part of the active surface of the counting tube cathode. (B.G.D.)

39265 RADIATION MEASURING INSTRUMENT. (to Mecewa A.G.). British Patent 1,073,236. June 21, 1967. Priority date July 26, 1963, Switzerland.

A radiation measuring instrument comprising a detection element, a pulse amplifier, and a ratemeter for continuous indication of the mean value of the radiation intensity is described. The pulse amplifier and the ratemeter have temperature-sensitive characteristics adjusted such that they compensate each other. (B.G.D.)

39266 HIGH SENSITIVITY NEUTRON IONIZATION CHAMBER. Schuricht, Volkmar; Frey, Wolfram (to Veb Vakutronik). British Patent 1,076,826. July 26, 1967. Filed Oct. 28, 1964.

Two ionization chambers for measuring the flow of thermal neutrons are described. One consists of a chamber containing a boron carbide-coated electrode which faces the sensitive volume of the chamber and the other contains boron trifluoride gas between the electrodes. Alpha particles are produced by the reaction $^{10}B(n,\alpha)^7Li$ in the chamber thereby producing currents which can be measured. (B.G.D.)

39267 DETECTOR FOR IONIZING RADIATION. Hosemann, Rolf; Warrikhoff, Harald. British Patent 1,082,144. Sept. 6, 1967. Filed Sept. 9, 1964.

A radiation detector is described which includes two electrodes, one of which has many layers of different materials, lined up in the intended direction of the incident radiation. The materials and their thicknesses are chosen for a given frequency range of ionizing radiation. The charge flow between the electrodes results from the emissions from the various layers and the degree of their absorption in any other layer in their path is proportional to the time integral of the intensity of the radiation. (B.G.D.)

39268 IMPROVEMENTS IN RADIATION-RESPONSIVE PROPORTIONAL COUNTER TUBES. (to Philips Electronics and Pharmaceutical Industries Corp.). British Patent 1,082,697. Sept. 6, 1967. Priority date Oct. 18, 1963, United States.

A rare gas-filled cylindrical proportional counter is described. The counter consists of a hollow cylinder having a conductive inner surface operating as a cathode and a thin wire as an anode. (B.G.D.)

Radiation Dosimeters

39269 (COO-1105-124) BIBLIOGRAPHY OF THERMOLUMINESCENT DOSIMETRY. Lin, F. M.; Cameron, J. R. (Wisconsin Univ., Madison. Dept. of Radiology). [1967]. 60p. Dep. CFSTI.

Four hundred and fifty-three (453) references are presented on thermoluminescent dosimetry under the following categories: radiation dosimetry, other applications, theory, phosphors, instrumentation, and general. (B.G.D.)

39270 (SZS-7/67) ^{24}Na-GANZKOERPERAKTIVITAET ALS MITTEL ZUR NEUTRONEN-HAVARIE-DOSIMETRIE. (^{24}Na Whole-Body Activity as a Means for Neutron Damage Dosimetry). Loessner, V. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). May 1967. 50p. (In German). Dep.

A general view is presented about neutron dosimetry in radiation accidents by means of ^{24}Na body activation. The general possibilities for in vivo measurements of the ^{24}Na activity are discussed, specially the possibilities with an experimental whole-body-counter. A short summary of the physical tasks, which are needed after an accident in a mixed neutron-γ field in the special view of the radiation protection situation in the GDR is also included. (auth)

39271 $^{14}N_2O$ AND $^{15}N_2O$ DOSIMETERS FOR MIXED GAMMA AND THERMAL-NEUTRON RADIATION FIELDS. Brown, R. D.; Dondes, S.; Harteck, P. (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Appl., 3: 581-2(Sept. 1967).

The nitrous oxide dosimeter will measure the absorbed dose in a mixed radiation field of gamma rays and thermal neutrons. The effect of the latter is due to the $^{14}N(n,p)^{14}C$ reaction (cross section 1.78 b). However, $^{15}N_2O$ has an extremely small cross section for thermal neutrons (0.02 mb) and thus measures only the gamma dose. Our studies using $^{14}N_2O$–$^{15}N_2O$ mixtures show that $^{14}N_2O$ and $^{15}N_2O$ dosimeters can discriminate between ionizing radiation and thermal-neutron effects. (auth)

39272 THERMAL DECAY OF ZnS–Ag AND THE DEPENDENCE OF THE QUENCHING RATE ON THE TEMPERATURE FOR EXCITATION WITH α-PARTICLES. Bezel, V. S.; Gavrilov, F. F.; Murin, V. I. Tr. Ural. Politekh. Inst., No. 143, 36–40(1965). (In Russian).

Thermal decay curves and the quenching rate were determined for silver-activated zinc sulfide single crystals after excitation by alpha particles. It is shown that small traps situated at a depth of 0.15 eV from the conduction band are responsible for the short component of quenching of the scintillations and that the decaying action of the exciting alpha particles has an effect on the quenching process. (B.G.D.)

39273 EFFECT OF A CONSTANT ELECTRICAL FIELD ON THE AMPLITUDE DISTRIBUTION OF α-SCINTILLATIONS IN ZnS–Ag. Gavrilov, F. F.; Rozhdestvenskii, V. N.; Prokhorov, N. D.; Panov, V. P. Tr. Ural. Politekh. Inst., No. 143, 45–7 (1965). (In Russian).

The effect of a constant electric field on the amplitude distribution and total light current of alpha-radioinduced scintillations in silver-activated zinc sulfides is discussed. The amplitude of the alpha-radioinduced scintillations decreases and the maximum number of impulses increases as the strength of the field increases. The decrease in amplitude indicates either internal quenching in the crystal or polarization. The increase in the maximum number of pulses is not related to the change in amplitude but is possibly due to the simultaneous interaction of the electric field and alpha particles. (B.G.D.)

39274 DOSE MEASUREMENT OF X AND RADIOACTIVE RADIATIONS BY THE CALORIMETRIC METHOD. Hordos, Miklos (Lajos Kossuth Univ., Debrecen, Hungary). Magy. Fiz. Foly., 15: 109-23(1967). (In Hungarian).

Calorimetric dosimetry is based on the determination of the heat generated by the absorption of radiation; it may be used to determine the total energy emitted by a radiation source or by a beam. Ideally, the design must ensure that the total energy is transformed into heat, but even when this is not the case, the method may be used for comparative measurements. It was employed in 1903 by Pierre Curie, et al., to determine the heat released by radium and its decay products. The absorbing medium must have a sufficiently high heat sensitivity to be subject to a marked temperature change as the result of the radiation. This temperature change is determined by a thermal column or a thermistor. Electric heating is used to calibrate the apparatus; the dose rate may be calculated from the temperature change per unit time. Dose measurement of pure β emitters is relatively easy. Differential calorimetry is used for determining the dose of α sources, f.i., to calculate the half-life of ^{242}Cm. The heat generated by ^{239}Pu, allowing to determine the half-life of ^{239}Pu was measured by an isothermal, $\alpha-\beta$ sensitive instrument. Measurement of γ radiation requires large amounts of the absorbent. The calorimetric principle was successfully applied also for measurements in the flux of reactors. (Review article, 27 references). (TTT)

39275 CALORIMETER FOR MEASURING γ-RADIATION ABSORPTION DOSE. Bregadze, Yu. I.; Vasil'eva, O. I.; Isaev, B. M.; Tultaev, A. V. Izmer. Tekh., No. 7, 60-3(July 1967). (In Russian).

Descriptions are given of a calorimetric device capable of measuring γ-radiation absorption doses of 5 rad/sec with the order of error not exceeding 1%. The feasibility of using polystyrene as absorption material in calorimeters is analyzed. (R.V.J.)

39276 ANNEALING OF A LiF THERMOLUMINESCENCE DOSIMETER. Shragai, A. (National Inst. of Radiological Sciences, Chiba, Japan). Health Phys., 13: 1040-42(Sept. 1967).

The remarkable enhancement of LiF thermoluminescence by plastic deformation and annealing has been recognized. In order to know the optimum method of annealing, the changes in the glow curve were observed as a function of heating time, heating temperature and cooling rate. Re-annealing effects were also investigated. (auth)

39277 DOSIMETRY OF 14-MeV NEUTRONS WITH EASTMAN NTA PERSONNEL MONITORING FILM. Kathren, R. L. (Univ. of California, Livermore). Health Phys., 13: 1039-40(Sept. 1967).

Knowledge of the response of Eastman NTA personnel monitoring film to 14-MeV neutrons is important in view of the increasing number of neutron generators utilizing the D-T reaction. A few theoretical analyses have been made to predict the response of this film to 14-MeV neutrons, and these have been supported by limited experimental data. There are, however, discrepancies between the experimental data of different investigators. NTA films were exposed to 14-MeV neutrons generated by the $^{3}H(d,n)^{4}He$ reaction. The fluence was determined to within ±10% by measurement of the power level of the accelerator beam. Within 24 hr after exposure all films were developed simultaneously for 5 min in Kodak Liquid X-ray Developer held at 20 ± 1°C. Proton recoil tracks were counted by direct microscopy at 470 × over a total area of at least 0.023 cm^2 (20 fields). (auth)

39278 DOSIMETRY AND EXPOSURES IN NUCLEAR ACCIDENTS. Auxier, J. A. Nucl. Safety, 8: 382-5(Summer 1967). (ORNL-P-2755).

There have been several developments in dosimetry for nuclear accidents, and there has been one nuclear reactor accident. The most important dosimetric development was the solid-state track detector for use with the fission-foil detector. Little specific information has been made available on the nuclear accident, which occurred at Mol, Belgium, on Dec. 30, 1965. (auth)

39279 PHOSPHATE GLASS FOR X-RAY, GAMMA-RAY, AND THERMAL NEUTRON DOSIMETERS. Carpentier, Serge; Delarue, Roger; Francois, Henri; Grand-Clement, Anne Marie; Portal, Guy; Soudain, Georges (to Commissariat a l'Energie Atomique). British Patent 1,078,793. Aug. 9, 1967. Priority date Mar. 5, 1965, France.

A new phosphate glass was developed for gamma-ray, x-ray, and thermal neutron dosimetry. The glass consists of aluminum, beryllium, lithium, silver, and sodium oxides and phosphorus pentoxide. The relation between the relative abundances of several of these oxides and the sensitivity variations of the glass is examined. (B.G.D.)

Radiometric Instruments

Refer also to abstracts 39142 and 39331.

39280 GAMMA BACKSCATTER TECHNIQUE FOR LEVEL AND DENSITY DETECTION. McConnell, J. A.; Smuck, W. W. (Sun Oil Co., Philadelphia). Chem. Eng. Progr., 63: 79-82 (Aug. 1967).

The use of gamma radiation to detect liquid levels in towers and vessels has generally been confined to transmission of the radiation through the vessel to the detector diametrically opposite. Sun Oil Co. has been using the gamma backscatter technique, which takes advantage of the fact that some gamma photons are scattered back toward the source in an amount proportional to the material density and can be detected with an adjacent counter. The instrument used was the Densometer. This method is not limited by vessel diameter nor vessel internals since maximum radiation penetration is no more than 10 to 12 in. It has been used successfully to find liquid levels in reactors, accumulators, and fractionators with wall metal thickness as great as ⅞ in. After calibration, it has been used to determine liquid densities behind insulated walls of moderate thickness. (auth)

39281 GEOMETRICAL ARRANGEMENT AND EFFICIENCY OF MOISTURE DETECTION IN MEASUREMENT SYSTEM OF BETA RAYS. Hattori, Taikichi (Muroran Inst. of Tech., Tokyo). Denki Gakkai Zasshi, 87: 333-42(Feb. 1967). (In Japanese).

Experiments and Monte Carlo calculations were performed on the absorption and scattering of β rays in a geometrical arrangement in which a Pb collimator 2 mm thick was set up in front of a radioactive source ($^{90}Sr-^{90}Y$). It was shown that the counting rate of emitted electrons, in accordance with the position of the materials tested, depends upon the diameter of the hole of the collimator. Optimum conditions for detecting moisture content at high efficiency by changing the position of the materials tested and the diameter of the hole are given. The number of electrons detected was calculated by the Monte Carlo method, with consideration of the energy distribution of electrons emitted from the source and the effect of the collimator which controls the number of electrons incident on testing materials. This calculation was made with the aid of a digital computer; the results agreed with the experimental results. The relation between the count rate and the position of materials tested with the diameter change of the collimator was examined experimentally. In the curves of the count rate plotted against the position of tested materials, the smaller the diameter of the hole, the nearer to the detector the position with the maximum counting rate moved from the source. For extremely collimated radiation, the gradient of the curve increased monotonously as distance from the source increased. As the curve became flattest, when the position with maximum count rate was located at the mid-distance between the source and detector, measurement of moisture in continuously moving materials can be carried out with a higher accuracy in this arrangement. Curves of the sensitivity of moisture detection in accordance with the changes in the diameter of the hole and the position of materials are shown as functions of area density. (BBB)

39282 INSTRUMENTATION FOR SNOW GAGING: YESTERDAY, TODAY, AND TOMORROW. Smith, James L. Isotop. Radiat. Technol., 4: 227-37(Spring 1967).

Snow water content may be measured by any one of three basic systems: gravimetric sampler, pressure-pillow, and nuclear gage. Each of these systems is discussed and evaluated as to its usefulness. The development of each system is presented, and an attempt is made to predict the future instrumentation needed for study of snow structure and for measurement of snow water content for prediction of streamflow. (auth)

39283 RADIOISOTOPE-BASED EQUIPMENT IN THE USSR. Gerrard, Martha. Isotop. Radiat. Technol., 4: 249-50(Spring 1967).

Forty-eight relays and gages, of various types, based on radioisotopes were marketed last year in the USSR. The cost of this equipment varies from $250 to $11,000. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 39084, 39091, 39192, 39398, 40142, 40566, 40690, and 40718.

39284 (AERE-R-5499) SUMMARY OF ELECTRON-MICROSCOPE CONTRAST THEORY. Martin, D. G. (Atomic Energy Research Establishment, Harwell (England)). July 1967. 18p. Dep. CFSTI. UK 3s. 6d.

The principal equations relating to electron-microscope contrast theory are presented. They are particularly designed as a reference manual for those who are familiar with the underlying physical principles. The list of symbols at the end is intended to make each equation as understandable in isolation as possible. These notes are designed to supplement the book Electron Microscopy of Thin Crystals by Hirsch et al. (London: Butterworths, 1965). (auth)

39285 (BNWL-447) TECHNIQUE TO EVALUATE PROCESS CONTROL AND DATA HANDLING INSTRUMENTATION. Markillie, W. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1967. Contract AT(45-1)-1830. 97p. Dep. CFSTI.

A figure-of-merit model was developed to evaluate several process control and data handling instrumentation concepts proposed for the Fast Flux Test Facility (FFTF). The model first provides for the consideration of each instrumentation concept according to its performance in terms of safety, operating continuity, data handling, control quality, human factors and flexibility. It then directs the comparison of that performance with process control and data handling requirements included as part of the evaluation technique. The result of such a comparison is a measure of instrumentation concept worth expressed both qualitatively and quantitatively. The measure of worth and the cost of each concept become a basis for comparing the concepts and lead to the selection of one of them for FFTF. (auth)

39286 (IS-1599) ELECTRICAL DETECTION IN SPARK SOURCE MASS SPECTROGRAPHY. Svec, Harry J.; Conzemius, Robert J. (Ames Lab., Iowa). June 19, 1967. (CONF-670920-1). Dep. CFSTI.

From 4th International Conference on Mass Spectroscopy, Berlin, Germany.

An electric detection scheme is described for a spark source mass spectrograph. The ion source and data handling features are discussed. These are noise, interrupted ion beam, fluctuating ion beam, sparking conditions, sample inhomogeneities, duty cycles, energy spread of ion beam, dynamic range, peak identification and resolution, alternate photographic usage, data display, computer orientation, and cost. (B.G.D.)

39287 (NLCO-998) OPERATION OF A LEITZ MM5 METALLOGRAPH. Schaich, E. L. (National Lead Co. of Ohio, Cincinnati). Apr. 24, 1967. Contract AT(30-1)-1156. 12p. (CONF-670533-4). Dep. CFSTI.

From 21st AEC Metallographic Group Meeting, Upton, N. Y.

A Leitz MM5 metallograph is in use for uranium metallography at the National Lead Company of Ohio. This paper describes the instrument and discusses its advantages and disadvantages. (auth)

39288 (NP-16756) DISENO Y CONSTRUCCION DE UN GENERADOR DE SENALES MARKOFFIANAS. (Design and Construction of Markoff Signal Generator). Elguezabal Buchanan, Antonio (Instituto Politecnico Nacional, Mexico City. Escuela Superior de Ingenieria Mecanica y Electrica). 1963. 94p. (In Spanish). Dep.

Thesis.

A Markoff signal generator was designed and constructed using the formal methods of logical synthesis and the simulation of processes by means of causal apparatus. The structure of the Markoff signal is analyzed and the method used for the generation of the process are given. Both the Markoff and Poisson section were designed by logical synthesis. (J.S.R.)

39289 (NYO-72-149) DESIGN AND PREDICTION OF PERFORMANCE OF BUFFERED DATA STORAGE SYSTEMS FOR NON-STATIONARY RANDOMLY ARRIVING DATA. Hahn, Jack (Columbia Univ., New York. Dept. of Physics). [1965]. Contract AT-30-1-GEN-72. 255p. Dep. CFSTI.

Problems related to the logical design of a buffered data storage system for nonstationary randomly arriving data were considered. A method consisting essentially of simulation using a digital computer was developed to predict the performance of such a system for any given input distribution, and for various system parameters, and organizations. This method enables data losses to be predicted and their origin determined. The investigation was performed using input data and parameters which are expected from Columbia University's Nevis Synchrocyclotron slow neutron velocity spectrometer after contemplated improvements to the cyclotron are completed. The input data will have an arrival distribution characterized by a nonstationary Poisson distribution with rate, $\lambda(t) = Kt^{-1.2}$. The time interval of interest will extend from 20 to 3000 microseconds with respect to the cyclotron pulse. At t = 20 microseconds the data arrival rate is expected to be 10^7 events per second. Serial buffer systems were investigated

in detail. Series-parallel systems were considered and compared. In particular a limiting case of series-parallel buffers called a "tree" was studied. (auth)

39290 (RFP-964) PULSE AMPLIFIER USING INTEGRATED CIRCUITS. Tyree, W. H. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Aug. 23, 1967. Contract AT(29-1)-1106. 7p. Dep. CFSTI.

A 0 to 10 volt pulse amplifier utilizing low cost linear and logic integrated circuits and plastic encased transistors was built. The unit had a maximum gain of 350, noise input of 15 microvolts, adjustable risetime, and a coincident logic signal. (auth)

39291 (RHEL/R-134) RUTHERFORD LABORATORY DDP-224 SYSTEM HANDBOOK. Lord, D. H. (Rutherford High Energy Lab., Chilton (England)). Apr. 1966. 74p. Dep. CFSTI. UK 11s.

A system of special purpose peripheral equipment has been built up around the DDP 224/Orion double computer complex at the Rutherford Laboratory. This system is described in detail, and basic program examples are given showing how to operate all parts of the system. (auth) (UK)

39292 (SZS-8/67) DOSISWERTE AN DEN WAENDEN EINES BESTRAHLUNGSRAUMES FUER DIE KONVENTIONELLE ROENTGENTIEFENTHERAPIE. (Dose Values on the Walls of an Irradiation Room for Conventional X-Ray Depth Therapy). Kirsch, M.; Schumann, E.; Haun, U. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). June 1967. 14p. (In German). Dep.

Radiation doses on the walls of a treatment room for conventional x-ray depth therapy were measured by 1300 films regularly distributed to the walls and the ceiling as well as by ionization chambers. By reasons of our treatment technique only a limited region of the wall is irradiated by the direct x-ray beam, because the beam is predominantly directed to the ground (vertically or aslant). The measured radiation doses on the walls are relatively small. The average number of adjustments per week, the administered surface doses, and the real time for turning on the therapy equipment (gathered from the tube load book) are presented. The measurements show, that the demands from standard TGL 16846 for the time turning on the equipment agree with the actual radiation protection situation. (auth)

39293 (UCRL-50293) CORRELATION OF HEAT OF FUSION AND OPTICAL DENSITY IN PENTON WITH ABSORBED DOSE USING A PROPOSED SPECTRUM FOR THE XRD-6 X-RAY MACHINE. Mallon, Barbara J. (California Univ., Livermore, Lawrence Radiation Lab.). May 1967. Contract W-7405-eng-48. 16p. Dep. CFSTI.

Penton specimens were exposed to x rays from the XRD-6 x-ray machine operated at 50 peak kV. Incident fluxes were 25, 50, and 100 cal/cm^2 either unfiltered or with zinc or titanium-aluminum filters. The Penton samples irradiated consisted of layers of ½ in.-diam discs in the range of 0.0254- to 0.070-mm thickness so that the radiation damage could be studied as a function of depth as well as dose and energy spectrum. The XRD-6 spectrum proposed by Taylor was used as the basis for calculation of absorbed dose as a function of depth for each exposure. The Taylor spectrum peaks at 10 keV with 46% of the energy between 4.2 and 15.0 keV. Melting points, heats of fusion, and optical density at 580 nm of irradiated Penton discs were determined and plotted against absorbed energy. Within experimental error, a single linear function correlates all the data for calculated dose absorbed versus experimental melting point and another linear function correlates calculated absorbed dose versus experimental heat of fusion. A single curve correlates the data at two 25-cal/cm^2 exposures, one unfiltered and the other with a zinc filter, for optical density versus absorbed dose. Because assumption of either a less energetic or a more energetic spectrum markedly increases the dispersion of the data, these results are taken as a strong confirmation of the Taylor spectrum. In addition, the linear relationship between absorbed dose and heat of fusion or melting point appears to be consistent with the random scission mechanism postulated in the literature for radiation damage in Penton. The use of Penton as a radiation dosimeter for x rays of 5 to 15 keV and absorbed doses of 0 to 400 cal/g appears promising. Heats of fusion of samples annealed after exposure and melting points of samples heated to 230°C and naturally cooled to room temperature appear reliable measures of dosage. Optical density may be an even better indicator for low dosage and offers greater ease of measurement. However, the color stability of irradiated Penton as a function of time, temperature, and the presence of oxygen must be evaluated before optical density can be considered a reliable measure of dosage. (auth)

39294 THEORY OF A SATELLITE ELECTROSTATIC PROBE. Parker, Lee W. (Mt. Auburn Research Associates, Inc., Cambridge, Mass.); Whipple, Elden C. Jr. Ann. Phys. (N.Y.), 44: 126-61(Aug. 1967).

A theoretical study is presented of the properties of a circular planar electrostatic probe, flush-mounted in the skin of a satellite. This geometry results in a two-dimensional potential distribution. The current–voltage characteristics of the external aperture grid and of an internal repelling collector (for attractive aperture-grid potentials) are investigated by means of several techniques involving detailed analysis of particle trajectories. An approximate theory is found to give useful insight into the properties of the probe. More exact numerical calculations are made by following trajectories in the field of the probe when the Debye length is infinite (Laplace field) and when the Debye length is finite (Poisson field). The Poisson field is computed by an iterative technique in which the charge densities in the Poisson equation are evaluated by summing charge contributions over trajectories. It is found that when the internal collector is repelling with respect to the plasma, its current–voltage characteristic is similar to that of a repelling probe, regardless of the fact that the external aperture grid is attractive. This has important consequences for satellite experiments. (auth)

39295 PARTICULAR APPLICATIONS OF MULTICHANNEL ANALYZERS. Sicard, F. Instrum. Nucl. (Paris), No. 29, 58-61 (May 1967). (In French).

Three new classes of utilization of multichannel analyzers are discussed. The first is that of analyzing the history of a counting rate whatever its origin. The second class is where the analyzer is associated with an oscilloscope. This makes it possible to increase the signal/noise ratio and then to augment the sensitivity of a large number of analysis methods. The third class permits, with the aid of an external accessory, the realization of inter- and auto-correlation functions on random phenomena. (J.S.R.)

39296 NUCLEAR ELECTRONICS AND INTEGRATED CIRCUITS. PRESENT STATE AND EVOLUTION. Lacour, J. (CEN, Grenoble, France). Instrum. Nucl. (Paris), No. 29, 64-9 (May 1967). (In French).

The introduction of nuclear electronics and integrated circuits into French and American nuclear installations is briefly outlined and their scope is compared. (J.S.R.)

39297 PHOTOMULTIPLIERS WITH VERY LOW BACKGROUND. Petit, R. Instrum. Nucl. (Paris), No. 29, 51-7(May 1967). (In French).

The principal characteristics of low-background photomultipliers are outlined and the methods used to measure the different characteristics are given. The improvements made to the photocathode, collection method, and decrease of the background as a result of the reduction of the cesium used and the use of low-potassium glass are discussed. (J.S.R.)

39298 PHOTOMULTIPLIERS IN NUCLEAR PHYSICS. LIMITS WHICH THEY INTRODUCE IN THE PRECISION OF MEASUREMENTS. Pietri, G. (Laboratoires d'Electronique et de Physique Appliquees, Paris). Instrum. Nucl. (Paris), No. 29, 36-50(May 1967). (In French).

The succession of transformations that the signal received by the photomultiplier undergoes during its conversion and amplification is briefly analyzed, in order to show why the precision is progressively altered, to determine how this alteration can be minimized, and to indicate possible improvements of the instrument. The constituent elements of a photomultiplier are given. The amplitude fluctuations of the anode pulses are analyzed. The transfer of electrons and its fluctuations with time is considered. The importance of the response of the multiplier to a single electron is emphasized. The contributions of the various constituents of a photomultiplier to the transit time fluctuations are determined. (J.S.R.)

39299 TIME RESOLUTION STUDIES ON LARGE PHOTOMULTIPLIERS. McDonald, W. J.; Gedcke, D. A. (University of Alberta, Edmonton). Nucl. Instrum. Methods, 55: 1-14 (Sept. 1967).

Two dimensional analysis has been used to obtain the time resolution as a function of fractional triggering level for an XP1040 photomultiplier. The sources of illumination included a light pulser and neutron induced scintillations from two NE213 scintillators of different size. The optimum triggering level varied between 10% and 20% depending on the light source. In the case of the pulser the results conflict with the findings of other workers and an explanation for this discrepancy is proposed. Recent theories of time resolutions in scintillation detectors are compared with the scintillator results. Qualitative agreement is obtained but the comparison indicates a need for a more sophisticated treatment of light collection and transit time effects. The problem of optimization of time response is discussed and a simple method for adjusting the photo-

multiplier grid potentials to obtain the best time resolution is described. (auth)

39300 VARIABLE FREQUENCY TUNNEL DIODE RELAXATION OSCILLATOR. Smith-Saville, R. J. (Univ. of Manchester, Eng.). Nucl. Instrum. Methods, 55: 120-4(Sept. 1967).

A current controlled wide range variable frequency tunnel diode relaxation oscillator circuit is described and analyzed. It is shown that the oscillation frequency is linearly proportional to control current over a wide range. Experimental results are presented for two circuits, one with a frequency range greater than 200 to 1, and both are shown to be in good agreement with theoretical predictions. (auth)

39301 LINEAR GATE WITH HIGH PRECISION. Smith, B. (CERN, Geneva). Nucl. Instrum. Methods, 55: 138-40(Sept. 1967).

The design of a fast linear gate is discussed. It achieves good stability and, at the same time, high speed, by the use of separate dc stabilizers to the fast circuits. It will transmit pulses of either polarity with a rise- and fall-time of 2.5 nsec, and is completely dc coupled. (auth)

39302 MULTI-STOP TIME-OF-FLIGHT ENCODER. White, G. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods, 55: 157-64(Sept. 1967). (AERE-R-5316).

A multi-stop time-of-flight encoder that will accept up to 4 stop events per start pulse is described. The channel width can be easily varied down to 3 nsec for 2000 channels or 1 nsec over a more restricted number of channels and the dead-time after a stop pulse is 10 nsec. The results of a simple experiment into after pulsing in photomultipliers using this instrument are also presented. (auth)

39303 MODIFICATIONS TO THE TMC MODEL 210 PULSE HEIGHT LOGIC UNIT. Gedcke, D. A.; Olsen, W. C. (Univ. of Alberta, Edmonton). Nucl. Instrum. Methods, 55: 177-82(Sept. 1967).

An input amplifier was designed to modify the TMC Model 210 pulse height logic unit to accept +10 V pulses from external transistor amplifiers. Improvements were made in the reliability and flexibility of the lower level trigger circuit. The problem of severe base line shifting with changing counting rate has been traced to the linear gate and eliminated. The new input amplifier also eliminates the large 60 cps ac ripple present in the original design. (auth)

39304 MULTICHANNEL PULSE-HEIGHT ANALYZER. Nekhai, A. P.; Marchenkov, V. V. (Physical-Technical Inst., Leningrad). Prib. Tekh. Eksp., No. 2, 112-16(Mar.-Apr. 1967). (In Russian).

The design and performance of a transistorized multichannel pulse-height analyzer are described. The analyzer is based on a linear discharge of a capacitor charged up to the magnitude of one of the incoming signals which is proportional to the amplitude of another incoming signal. (tr-auth)

39305 CALORIMETER–COLLECTOR FOR MEASURING ACCELERATED ELECTRON ENERGIES. Radzievskii, G. B.; Glazunov, P. Ya.; Varin, A. N. (Inst. of Physical Chemistry, Moscow). Prib. Tekh. Eksp., No. 2, 105-8(Mar.-Apr. 1967). (In Russian).

Descriptions are given of a device for measuring average energy of accelerated electrons. The device is a combination of a total absorption calorimeter and a Faraday cylinder. The electron energy is obtained as a quotient of the thermal power and beam current. The results of calibration for the accelerator energy of 1.2 MeV and determination of dE/dx materials of low atomic number are presented. (tr-auth)

39306 ASSOCIATIVE SEARCH FOR INFORMATION USING DIRECT MEMORY SYSTEMS. (REVIEW). Ofengenden, R. G.; Berezin, F. N. (Inst. of Physics, Kiev). Prib. Tekh. Eksp., No. 2, 5-13(Mar.-Apr. 1967). (In Russian).

The fabrication of a multichannel pulse analyzer for recording a wide range of information is described. Methods of automatic determination of various principles of associative searches for information by using memory devices are discussed. (tr-auth)

39307 LOW POWER HIGH VOLTAGE INDICATOR FOR PHOTOMULTIPLIERS. Stephens, W. A. (Univ. of Virginia, Charlottesville). Nucl. Instrum. Methods, 54: 150(Sept. 1967).

A high potential indicator for photomultipliers utilizes a simple neon lamp relaxation circuit which operates directly from the high voltage and offers good visibility at very low current. (auth)

39308 OVERLOAD PROTECTION CIRCUIT FOR CURRENT-FEEDBACK DC ELECTROMETERS. Kennedy, E. J. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Nucl. Instrum. Methods, 54: 144-6(Sept. 1967). (ORNL-P-2951).

A simple and inexpensive input protection circuit for current-feedback electrometers was developed utilizing complementary bipolar transistors. The circuit will effectively clamp the input voltage of the electrometer at ±0.6 V when an overload condition occurs. Under normal non-conductive operation the equivalent leakage current of the protection circuit is less than 1×10^{-14} A. (auth)

39309 SCALER-TIMER FOR PORTABLE INSTRUMENTS. Lovborg, L. (Riso Research Establishment, Roskilde, Denmark). Nucl. Instrum. Methods, 54: 137-8(Sept. 1967).

A compact scaler-timer with adjustable scale factor and counting period is described. The circuit is for the most part fully integrated and is powered from a rechargeable Ni–Cd battery. (auth)

39310 DEAD-TIME EFFECTS IN STANDARDISATION OF RADIONUCLIDES WITH FAST–SLOW COINCIDENCE SYSTEMS. Vayrynen, H. (Technical Univ. of Helsinki, Otaniemi, Finland). Nucl. Instrum. Methods, 54: 116-18(Sept. 1967).

The dead-time losses in fast-slow coincidence systems are investigated, considering specially the use of fast-slow systems in absolute measurements of radioactivity. The method is quite simple and the final formulas of the dead-time corrections are easy to use. They can be applied to systems, where the overall efficiencies of the detector channels are low, i.e., less than about 10% and where the pulse rates are not too high. (auth)

39311 COINCIDENCE OF HORIZONTAL AND VERTICAL FOCUSING PLANES FOR ELECTROMAGNETIC ISOTOPE SEPARATORS OF THE HOMOGENEOUS SECTOR TYPE. Chavet, I. (Soreq Nuclear Research Center, Yavne, Israel). Nucl. Instrum. Methods, 54: 155-6(Sept. 1967).

In the optical design of electromagnetic isotope separators, it is frequently desired to obtain two-directional focusing. For machines of the homogeneous sector type, this can be achieved by a suitable choice of the incidence and emergence angles ϵ' and ϵ''. For simultaneous collection of isotopes over a wide mass range, it may further be desirable that the horizontal and vertical focusing planes coincide. The analytical expression for this optical condition is developed for arbitrary values of the object distance l' and the incidence angle ϵ'. Solutions of this equation are presented in graphical form. The effect of the extension of the fringe-field in actual cases is found to be negligible. (auth)

39312 ADVANCED COMPUTER-BASED NUCLEAR PHYSICS DATA ACQUISITION SYSTEM. Gelernter, H. L. (IBM Watson Research Center, Yorktown Heights, N. Y.); Birnbaum, J.; Mikelsons, M.; Russell, J. D.; Cochrane, F.; Groff, D.; Schofield, J. F.; Bromley, D. A. Nucl. Instrum. Methods, 54: 77-90 (Sept. 1967).

A sequence of particle-gamma correlation experiments have begun at the Yale Emperor tandem Van de Graaff accelerator, where all data acquisition, analysis, display, and experimental control functions are to be performed within the framework of a general integrated hardware-software nuclear physics data acquisition system designed for the IBM System/360 Model 44 scientific computer. The core of the system is a versatile control interface, which makes it possible to connect any of a modular and compatible series of digital output nuclear instrumentation directly to the computer by merely plugging the component directly into the control unit. Through the device of a diode plugboard, up to twenty-eight components, for which space is provided in the interface, may be designated as belonging to a given event (i.e., a particular interaction which is singled out by the experimenter's event detection logic), and when that event has been detected, the data generated in the components associated with that event, headed by a word identifying the event, are transmitted to the computer completely under channel-interface control in the cycle-steal mode without interrupting the activity of the central processing unit. As many as sixteen such events may be defined and provision is made for sharing a single component among any number of events. The initial system will be provided with 1024-channel 25 MHz ramp-type analog to digital converters, 25 MHz scaler/timers, and monitor registers. The latter are provided to allow the system to read standard logic levels, and may be used to connect other parallel output components to the system. Design approaches for a second generation of components with performance specifications significantly superior to those of the initial system have been considered. A set of programs to perform the tasks of data acquisition, data transformation and analysis, experiment control, and CRT display is in preparation. These subroutines, compiled by a FORTRAN-like language, provide light pen as well as conventional means of communication between physicist and computer, and are intended to make the computer-

based system as easy to use as a fixed wire multiparameter analyzer, with significant improvement in flexibility. The on-line processing routines will be embedded in a multiprogramming supervisor, so that compiling and debugging of process and non-process programs and general scientific computing may proceed simultaneously with on-line experiment processing when excess computing power is available. (auth)

39313 AN EVALUATION OF THE MAY-TYPE OF CASCADE IMPACTOR. Wells, B. J. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Health Phys., 13: 1001-13(Sept. 1967).

The performance of the May-type of cascade impactor (Casella Mk. 2 version) as an instrument for sizing solid particulate materials was determined using unit density spheres and the oxides of uranium and plutonium. It is shown that the instrument may be used to size aerosols, not necessarily of spherical particles, of materials over a wide range of density. Both effective cut-off sizes and mass median diameters may be employed as characteristic sizes for the jet stages. (auth) (UK)

39314 NaK-FILLED DIFFERENTIAL-PRESSURE INSTRUMENTS FOR HIGH-TEMPERATURE MEASUREMENTS. Lawford, Victor N. (Barton Instrument Corp., Monterey Park, Calif.). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-16, 6p., $1.50. (CONF-661102-21). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

NaK-filled transducers have been developed by several instrument makers for atomic reactor installations. Invariably, the transducers were force-balance type that necessitated electric or pneumatic power to produce an indication of the process conditions. NaK-filled differential-pressure instruments of the motion-balance type for direct indication are described. (auth)

39315 ANALYSIS INSTRUMENTATION. VOLUME 4. Proceedings of the Twelfth Annual ISA Analysis Instrumentation Symposium, held May 11-13, 1966 at Houston, Texas. Fowler, Lewis; Harmon, Raymond G.; Roe, David K. (eds.). New York, Plenum Press, 1967. 244p. $12.50. (CONF-660567-(Vol.4)).

Twenty-five papers were presented at the Twelfth Annual ISA Analysis Instrumentation Symposium. Topics included electromechanical methods, air pollution, chemical methods of analysis, optical methods, radiation methods of analysis, water pollution, laboratory chromatography, and process chromatography. (B.G.D.)

39316 MASS SPECTROGRAPH ION SOURCE WHEREIN A PULSED ARC IS PRODUCED BY VIBRATING ONE ELECTRODE. Friedman, L.; Irsa, A. P. (to U. S. Atomic Energy Commission). U. S. Patent 3,337,728. Aug. 22, 1967.

An ion source for a mass spectrograph is described. The source has a vibrating anode and a cathode shaped to confine a plasma producing arc produced between the anode and cathode so that the plasma has only a limited means of escape for efficiently extracting ions. The source is used in analyzing samples of limited size. (AEC)

Radiation Effects on Instruments and Instrument Components

Refer also to abstract 39654.

39317 (SC-RR-67-312) NEUTRON RADIATION DAMAGE IN SILICON TRANSISTORS. Goben, C. A.; Smits, F. M.; Wirth, J. L. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. Contract AT(29-1)-789. 42p. Dep. CFSTI.

From a study of base and collector current as a function of the emitter-to-base voltage, it was found that neutron-induced base current has components originating in the emitter space charge region as well as the neutral base region. At low injection levels the neutron-induced base current is dominated by the space charge component, whereas the high injection behavior appears to be controlled by recombination in the neutral base region. Additional experiments performed in special tetrode transistors and van der Pauw-type samples indicate that changes in collector current are dominated by recombination in the neutral base, while changes in base doping and mobility have only a secondary effect. These conclusions are reached from experiments on transistors with a ring emitter, on tetrode-type test transistors, and on special Hall-effect devices. (auth)

39318 EFFECT OF γ RADIATION ON RESONATORS WITH DIELECTRIC-LAYERED WALLS OF $BaTiO_3$ CERAMICS. Uralov, G. A. (Tomsk Order of Labor Red Banner Polytechnic Inst. USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 144-6 (1967). (In Russian).

The investigation was made in connection with the use of the resonators in waveguide synchrotrons. In the resonators, $\epsilon \sim 100$ and $\tan\delta \sim 5 \times 10^{-3}$. The resonators were excited with a 3000 μcps TEM mode. The side walls of the resonator were made of brass tube with a 35-mm inside diameter. The Q-factor of a resonator with one wall consisting of three dielectric layers was 92% of the Q-factor of a resonator with a metallic wall; the Q-factor of a resonator with two dielectric walls with the same number of layers in each wall was 81% of that of a resonator with a metallic wall. A further increase in the number of dielectric disks does not lead to a noticeable increase of Q. Thus, the metallic walls of coaxial resonators can be replaced by dielectric walls without any considerable change in Q-factor. The effect of gamma-radiation from a ^{60}Co source on $BaTiO_3$ ceramics showed that penetration in the emission field up to 10^8 r remains unchanged, while the tangent of the angle of losses changes by approximately two times. A two-fold change in the tangent of the angle of losses changes the Q-factor of the resonator less than 4%. A noticeable change of Q-factor of the resonator under the effect of gamma-radiation can be expected only when the losses in the dielectric walls are comparable to those on their metallic walls. Thus, gamma radiation with an energy of the order of 1 MeV and a dose rate of 150 r/sec does not lead to a considerable change in the Q-factor of coaxial resonators with layered ends made from $BaTiO_3$ ceramics up to an integral dose of 2×10^7. (auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 38969, 39373, 39375, 39434, 39446, 39500, 39512, 39531, 40564, and 40736.

39319 (AD-631232) GAS CHROMATOGRAPHIC ANALYSIS OF BODY FLUIDS FOLLOWING MIDLETHAL IRRADIATION. Final Report. Gross, Arthur L.; Kibler, George K. (Southwest Research Inst., San Antonio, Tex. Dept. of Physical and Biological Sciences). Dec. 15, 1965. Contract AF41(609)-2676. 14p. CFSTI.

Gas chromatographic procedures were used for screening a large number of chemical substances to determine what alterations result from radiation exposure. Rats were irradiated, blood or urine was collected from the animals, and gas chromatographic analyses were performed using three different methods. During the last quarterly period of the program monkeys were used as the experimental animals. They were irradiated and blood samples periodically taken from the animals were analyzed for amino acids. (TAB)

39320 (AD-632250) PRECIPITIN RESPONSE TO HUMAN SERUM BY A RABBIT POPULATION. COMPARISON OF STRESSES ON SECONDARY PRECIPITIN RESPONSES. [Progress] Report, May 1961-June 1964. Sutherland, G. Bonar; Glenn, W. G. (Saskatchewan Univ., Saskatoon. Dept. of Physiology and Pharmacology. School of Aerospace Medicine, Brooks AFB, Tex.). Apr. 1966. Contract AF41(657)-384. 11p. (SAM-TR-66-27). CFSTI.

The report analyzes the secondary precipitin response of a population of rabbits subjected to various stresses and stress combinations. As administered in this experiment, the following stresses and stress combinations produced a statistically significant depression of precipitin production (compared to controls) during the anamnestic response of rabbits to a complex antigen (human serum). These are rank-ordered with the stress producing the greatest effect at the head of the list: 6-mercaptopurine; 800 R whole-body γ radiation immediately followed by 10 days at a simultated altitude of 15,000 ft; splenectomy followed 21 days later by 800 R of γ radiation; 800 R whole-body γ radiation or 15,000-ft simulated altitude for 10 days followed by 800 R whole-body γ radiation; and splenectomy. The following stresses showed no significant effect: 15,000-ft simulated altitude during the induction period; 15,000-ft simulated altitude for 10 days before the induction period; major surgery involving implantation of dosimeters. Whole-body γ radiation (800 R) immediately followed by 15,000-ft simulated altitude resulted in a mortality of 58% within the first 48 hours of decreased atmospheric pressure. Altitude exposure before 800 R γ radiation did not indicate any synergism or antagonism related to the anamnestic response. Stress did not appear to increase antibody levels in the absence of a booster injection. (TAB)

39321 (BMI-171-002) BIOENVIRONMENTAL AND RADIOLOGICAL-SAFETY FEASIBILITY STUDIES ATLANTIC-PACIFIC INTEROCEANIC CANAL. HYDROGEN BUDGET AND COMPARTMENTS IN THE RAIN FOREST AT EL VERDE, PUERTO RICO, PERTINENT TO CONSIDERATION OF TRITIUM METABOLISM. Odum, Howard T. (Puerto Rico Nuclear Center, Mayaguez). June 1, 1967. Contract AT(29-1)-171. 36p. Dep. CFSTI.

For Battelle Memorial Inst., Columbus, Ohio.

From data on rainfall, throughfall, stemflow, evaporation, transpiration, percolation, photosynthesis, and respiration from the montane forest at El Verde, Puerto Rico, a hydrogen compartmental diagram with flow rates and compartmental storages was prepared. This diagram permits computation of transient phenomena for the flow of tritium in a tropical forest assuming a knowledge of the extent and the duration of the tracer input. A mathematical model for tritium transfer, based upon this diagram, is given. The story at El Verde is found to be somewhat comparable to that of Panama during its wet season as their rainfall and saturation deficits are similar. (auth)

39322 (CEA-R-3108) METABOLISME DU ^{137}CESIUM, ^{137}BARYUM CHEZ LE RAT. THERAPEUTIQUE DE LA CONTAMINATION. (Metabolism of ^{137}Cs, ^{137}Ba in the Rat. Therapeutics of the Contamination). Remy, Jacques; Philippon, Alain; Lafuma, Jacques (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb. 1967. 62p. (In French). Dep.

Results are reported from studies on the distributions kinetics, the metabolism, and excretion of ^{137}Cs and ^{137}Ba in the rat. These phenomena are shown to be independent of the method of applying a single dose. The distribution tended to remain the same depending on the body burden. Biological analysis of the state of cesium in the biological media showed that it was transported in the free and ionized form. Considering the problem of the method of penetration of the cesium ion in the intracellular medium, and in particular by the in vivo and in vitro kinetic study of the plasma-red cell system, it was concluded that an active transport of cesium occurs in the cell membrane. An overall picture of cesium distribution in the organism is presented that is essentially characterized by a dynamic distribution equilibrium between two compartments: 99 percent of the cesium accumulates in the intracellular pool, 1 percent in the extracellular liquids. Because of the active transport by the cell membranes, the intracellular pool is filled rapidly but discharge is slow. This phenomenon is the limiting factor in the decrease of the body burden. The reasons for the relative failure of the various methods to enhance excretion of cesium-137 are examined. The stimulation of the natural emunctories, in the case of diuretics for example, can only improve the purification of the extracellular compartment, which contains only 1 percent of the body burden. The methods designed to counteract or inhibit the active transport of cesium by the cell membrane are incompatible with the survival of the cell. (65 references.) (auth)

39323 (COO-1422-11) IN VIVO BONE MINERAL MEASUREMENTS OF THE RAT FEMUR. Smith, Everett; Cameron, John R.; Sorenson, James A. (Wisconsin Univ., Madison. Dept. of Radiology). Aug. 1, 1967. Contract AT(11-1)-1422. 10p. Dep. CFSTI.

The direct photon absorption technique was adapted for bone mineral determination in rats and other small animals. The equipment used is the same as that used for human bones. The diameter of the rat femur is about 1/3 that of the human radius; thus it was necessary to improve the collimation by decreased hole diameter. The ^{125}I beam is collimated at the source by a hole 0.7 mm in diameter. The photon detector is collimated by holes 2.0 mm in diameter in a pair of parallel lead plates 25 mm apart. The photon source and collimated detector are driven across the bone at a constant speed of .4 mm/sec by a 1 rpm synchronous motor. The automatic scaler-timer counts the detected photons during successive 0.4 sec intervals. This time interval corresponds to 0.16 mm wide intervals for sampling bone mineral across the bone being measured. The distance from the source to the detector is 7.5 cm which makes the point photon source of 27.3 KeV x rays reaching the detector more intense than in earlier works. The placement of rats for scanning is accomplished by moveable foot holders. An x ray is taken of each animal to observe the scanning path. The technique makes possible in vivo observations on the effects of diet, vitamin deficiency, limb immobilization, and exercise in bone mineral content. (C.H.)

39324 (NYO-3024-30) [ACTION OF TRITIATED TETANUS TOXIN AND TOXOID UPON THE ANTIBODY FORMING MECHANISM]. Final Report, August 1967. [Speirs, Robert S.] (State Univ. of New York, Brooklyn. Downstate Medical Center). Aug. 1, 1967. Contract AT(30-1)-3024. 6p. Dep. CFSTI.

Progress is reported in studies on cellular reactions to antigens. Techniques were developed to determine the total number and types of cells taking part in inflammation. Various physiological activities such as chemotaxis, phagocytosis, rosette formation, and intercellular bridge formation in inflammatory cells were studied under time-lapse phase microscopy. Tritium-labeled tetanus toxin was injected into tissues and its localization within various cells was determined by autoradiographic techniques. Measurements of serum antitoxin titers were made and correlated with cellular morphology and the histochemical changes observed in the inflammatory cells. Actinomycin D was observed to inhibit primary immunization to tetanus toxoid and yet have little effect on antitoxin production when given during anamnestic response. In some respects this drug mimics the effects of irradiation. A thorough study of the effects of actinomycin D on the hematopoietic system as well as the peripheral blood and inflammatory cell response was carried out. Results are reported from a study on the effects of actinomycin D on incorporation of tritium-labeled thymidine and uridine into nucleic acids in the spleen of mice and on carbon-14-labeled leucine incorporation into serum gamma globulin. Techniques involving electron microscopy and the injection of a marker substance such as carbon along with antigen were used to study the formation and size of agglutinates and the migration of inflammatory cells into the periotoneal cavity following the injection of antigen. (C.H.)

39325 (NYO-3557-2) [IMMUNOCHEMICAL STUDY OF MS2 BACTERIOPHAGE]. Progress Report, 1966–1967. Rappaport, Irving (New York Medical Coll., New York. Dept. of Microbiology). May 26, 1967. Contract AT(30-1)-3557. 21p. Dep. CFSTI.

Progress is reported on the following studies: inactivation of MS2 bacteriophage with rabbit antiserum; effects of RNAase on antibody-virus-cell complex; antigenic relations of the RNA phages; antibody specificity following secondary stimulation of rabbits with the heterologous phage antigen; effects of streptomycin on synthesis of antibodies in vitro by spleen and lymph node cells of rabbits; studies on different kinds of antibody molecules produced by single cells using spleen cells of mice previously injected with sheep red blood cells; fine structure of MS2 bacteriophage; antigenic study of defective tobacco mosaic virus protein. (H.L.W.)

39326 (ORO-1643-071) STUDIES IN IODINE METABOLISM. Progress Report, July 1966–July 1967. Van Middlesworth, L. (Tennessee Univ., Memphis. Dept. of Physiology and Biophysics). July 31, 1967. Contract AT(40-1)-1643. 23p. Dep. CFSTI.

Progress is reported on studies on iodine metabolism. Topics discussed include the nature of the thyroid iodine compartment that turns over very slowly; iodination of plasma albumin in hyperplastic thyroids; the histology of experimental cystic goiter in hamsters; the function of hyperplastic thyroids in experimental rats after hypophysectomy; the role of thiocyanate in the normal physiology of rats; the effects of thiocyanate on iodine metabolism; weight loss in patients with thyroid disease; and naturally occurring Ra in animal thyroids. During the year, thyroid glands from cattle, sheep, and a few human beings from all parts of the world were examined for ^{131}I content from fallout. The relation of ^{131}I in thyroids to announced atmospheric nuclear weapons tests is shown. A preliminary report regarding unexplained ^{131}I in the biosphere during the past 10 yrs is included. (16 references.) (C.H.)

39327 (TT-66-57008/3-4) POLISH ENDOCRINOLOGY. Volume 17, Nos. 3-4, 1966. Translation of Endokrynol. Pol., 17: Nos. 3-4, 245-511(1966). 126p. CFSTI.

An abstract was prepared for one article in the Polish journal Endokrynologia Polska, Vol. XVII, Nos. 3 and 4, 1966. Translations are included of 15 additional articles that discuss various aspects of endocrine gland function in health and various disease states. (C.H.)

For an abstract of the individual paper see: 39328.

39328 (TT-66-57008/3-4, pp 176-87) EFFECTS OF X-RAY IRRADIATION ON HISTOCHEMICAL REACTIONS IN RAT ADRENALS. Brzezinski, Ryszard. Translated from Endokrynol. Pol., 17: 307-20(1966).

The effects of whole-body x irradiation of rats on histochemical reactions in the adrenals were studied. It was concluded that single doses of 700 R enhanced, and single doses of 1200 R decreased, the rate of biosynthesis of corticosteroids in rat adrenal cortex. (auth)

39329 ULTRAVIOLET-INDUCED DAMAGE TO DNA INDEPENDENT OF MOLECULAR WEIGHT. Scholes, Charles P.; Hutchinson, Franklin; Hales, Harriet B. (Yale Univ., New Haven). Contract AT(30-1)-2653. J. Mol. Biol., 24: 471-4(1967).

The transforming activity of DNA that had first been sheared to a small size, then treated with uv light, was compared with the activity of DNA that had been treated with uv light, then sheared to the same small size. Transforming DNA was prepared from wild-type Bacillus subtilis. The transforming activity was identical whether the DNA was sheared before or after uv treatment, demonstrating that the change in survival with molecular weight of the DNA cannot be ascribed to any change in uv damage. The accumulation of one type of uv damage, thymine dimers, was followed for two different DNA samples, one with a molecular weight of about six $\times 10^6$ as measured by sedimentation, the other with a molecular weight of 165,000. The molecular weight of the DNA did not alter the yield of these lesions. Since it was previously shown that uv treatment of transforming DNA has little effect on the irreversible uptake in recipient cells, it appears that changes in the process by which transforming DNA is integrated into the genome of the recipient cell would be the most likely explanation for the shape of the uv survival curve, and the dependence on molecular weight. (BBB)

39330 THE PASSAGE OF ^{22}Na INTO THE UTERINE LUMEN OF THE RAT. Marley, P. B.; Robson, J. M. (Guy's Hospital Medical School, London). J. Physiol. (London), 189: 67P-68P (Apr. 1967).

The amount of ^{22}Na that passes from the extracellular fluid into the uterine lumen during a half-hour perfusion period was measured at different stages of the sexual cycle. Intravenously injected ^{22}Na passed slowly into Locke solution perfusing the uterine lumen. The amount of ^{22}Na recovered in the perfusate was independent of the perfusion flow rates investigated (0.2 to 1.0 ml/min) but dependent on the stage of the sexual cycle. It was also found that ^{22}Na diffused very slowly into the natural proestrous fluid of nonperfused rats (40% equilibration in 7.5 hr). Surprisingly, the least ^{22}Na was recovered from the lumen of the estrous uterus although it is hyperemic at this time. Larger amounts were recovered from diestrous uteri and from early pregnant and pseudopregnant uteri. On day four the barrier between the extracellular fluid and the uterine fluid apparently altered, for there was a sudden increase in the amount of ^{22}Na recovered. This change occurred just before the initiation of nidation in pregnant rats and at the corresponding stage in pseudopregnant rats, persisting in the latter case until day eight. In the pregnant rats, however, the perfusate ^{22}Na content temporarily decreased after blastocyst attachment on day five, but subsequently increased to reach values on day seven which were greater than in pseudopregnancy. (BBB)

39331 A MULTIPLE UNIT RADIOMETRIC RESPIROMETER FOR THE MEASUREMENT OF THE METABOLISM OF ^{14}C LABELLED SUBSTRATES. Bourke, J. B.; Faust, M.; Massey, L. M. Jr. (Cornell Univ., Geneva, N. Y.). Int. J. Appl. Radiat. Isotop., 18: 619-23(Aug. 1967).

An improved radiometric respirometer is described which permits periodic sampling of both the evolved $^{14}CO_2$ and the activity remaining in the substrate solution, as well as the complete recovery of added radioactivity. The system, although described for use with plant tissue may be used with insects or small animals. A procedure for the use of the system is described, and a typical experiment utilizing irradiated carrot tissue is discussed. (auth) (UK)

39332 ACTION OF ATOMIC HYDROGEN ON RIBONUCLEASE IN AQUEOUS SOLUTION. Holmes B. E. (Univ. of Cambridge, Eng.); Navon, G.; Stein, G. Nature (London), 213: 1087-91 (Mar. 18, 1967). (NYO-3242-17).

From the studies described it is concluded that atomic hydrogen appears to react with ribonuclease in aqueous solution not by attacking the molecule at random, but by reacting with specific amino acids in the enzyme. It appears to have a special affinity for aromatic and sulphur-containing amino acids, even though these may not be at the surface of the enzyme. It is assumed that after addition of an H-atom to the enzyme material an efficient process of irreversible material transfer follows, involving an H-atom or probably an electron. This mechanism of concentration of damage on sensitive sites should be differentiated from mechanisms involving excitation energy transfer. The role of free radicals is discussed. (UK) (INIS)

39333 THE INFLUENCE OF GONADAL HORMONES ON THE INCORPORATION OF RADIOACTIVE SULFUR (^{35}S) AT THE LEVEL OF THE NASAL MUCOSA OF A RAT. Villa, A.; Pesenti, M.; Girardi, G. (Univ., Milan). Med. Nucl. Radiobiol. Lat., 9: 461-76(1966). (In Italian).

The influence of gonadal hormones on the uptake of ^{35}S by the nasal mucosa of the rat was studied. The results showed that castration reduced and changed, even if in a small proportion, the uptake of the ^{35}S by the nasal mucosa. The administration of testosterone and estradiol increased the incorporation of ^{35}S in both normal and castrated animals. (B.H.S.)

39334 CHANGES IN NUCLEIC ACID CONTENT IN THE GEREN'S TUMOUR CELLS OF ALBINO RATS DURING COMPLEX THERAPEUTIC (X-RAY PLUS COLD METHOD OF TREATMENT). Keivan, M. D. Dopov. Akad. Nauk Ukr. RSR, Ser. A, No. 5, 458-60(1967). (In Russian).

The effect of complex therapy (x rays plus cold method of treatment) on content of nucleic acids in the cells of Geren's tumor was studied cytometrically. The investigation showed that a relation existed between content of DNA and RNA in tumor cell and the mode of the x-ray therapy. The largest quantity of nucleic acids was in the tumor cells of a control group. Nucleic acid content in the tumor cells was considerably decreased by the x-ray therapy, but under conditions of x-ray therapy with simultaneous local cooling to tumor, the DNA and RNA contents in the tumor cells decreased even more. (auth)

39335 GRAMICIDIN, VALINOMYCIN, AND CATION PERMEABILITY OF STREPTOCOCCUS FAECALIS. Harold, F. M.; Baarda, J. R. (National Jewish Hospital, Denver. Univ. of Colorado, Denver). J. Bacteriol., 94: 53-60(July 1967).

Gramicidin and valinomycin in concentrations of 10^{-7} and 10^{-6} M, respectively, inhibited the growth of Streptococcus faecalis. Inhibition of growth was associated with loss of Rb^+ and K^+ from the cells, and could be reversed by addition of excess K^+. Cells treated with these antibiotics exhibited greatly increased per-

meability to certain cations, no effect was observed on the penetration of other small molecules. Unlike normal cells, cells treated with gramicidin rapidly lost internal Rb^+ by passive exchange with external cations, including H^+, all monovalent alkali metals, NH_4^+, Mg^{++}, and tris(hydroxymethyl)aminomethane. Exchange was rapid even at 0°C and was independent of energy metabolism. The effect of valinomycin was more selective. Cellular Rb^+ was rapidly displaced by external H^+, K^+, Rb^+, and Cs^+; other cations were less effective. The exchange was independent of metabolism but strongly affected by temperature. Under certain conditions, polyvalent cations inhibited exchange between ^{86}Rb and Rb^+ induced by valinomycin. The antibiotic apparently neither stimulates nor inhibits the energy-dependent K^+ pump of S. faecalis, but exerts its effect on the passive permeability of the membrane to cations. The increased permeability to specific cations induced by gramicidin and valinomycin is a sufficient explanation for the inhibition of growth, glycolysis, and other processes. (auth)

39336 SOLUBILITY OF ^{133}Xe AT 37°C IN WATER, SALINE, OLIVE OIL, LIQUID PARAFFIN, SOLUTIONS OF ALBUMIN, AND BLOOD. Ladefoged, J.; Andersen, A. M. (Glostrup Hospital, Copenhagen). Phys. Med. Biol., 12: 353-8(July 1967).

Results are tabulated for the solubility of ^{133}Xe at 37°C in the above substances. The solubility of xenon in blood was found to follow Henry's law at pressures up to one atmosphere. (auth) (UK)

39337 EFFECT OF IRRADIATION ON THE ANTISTREPTOKINASE ACTION OF "EACA" AND OF "AHG". Szirmai, E.; Berkarda, B.; Derman, U. Nucl. Energy, 93-4(May-June 1967).

It was found that x-irradiation of 6-aminocaproic acid (EACA) to 1200 R did not significantly diminish its inhibitory effect on streptokinase and streptodornase (SK and SD) activity, checked on euglobulin clots and plasma plates. It was also found that irradiation to 1200 R did not diminish the correcting activity of antihemophilic globulin (AHG) as regards recalcified plasma and partial thromboplastin clotting times; in fact it produced a shortening of clotting time, suggesting some activation. (UK)

39338 UPTAKE OF ^{32}P AND ^{45}Ca BY PURE AND MIXED CULTURES OF BACTERIA. Varma, Man M. (Howard Univ., Washington, D. C.); Stonefield, David H. Purdue Univ., Eng. Bull., 50: Ext. Ser. No. 121, 103-16(Mar. 1966).

From 21st Annual Purdue Industrial Waste Conference, Lafayette, Ind., May 3-5, 1966. See CONF-660523-(Pt.1).

The cultures used were Escherichia coli and Proteus vulgaris. Results show a good correlation between the growth of bacteria and uptake of P. It was found that during the death phase, the release of P into the medium by the dead cells is slower than the bacteria death rate. Carbon-45 was not readily assimilated by the bacteria. (J.R.D.)

39339 GLUCOSE REQUIREMENT FOR DNA BREAKDOWN RESULTING FROM TREATMENT OF BACILLUS SUBTILIS WITH ULTRAVIOLET RADIATION OR METHYL METHANESULFONATE. Searashi, T.; Strauss, B. (Univ. of Chicago). Mutat. Res., 4: 372-5(May-June 1967).

The degradation of DNA in Bacillus subtilis after treatment with methyl methanesulfonate (MMS) or uv radiation was stimulated by glucose. Breakdown of DNA was measured as the release of TCA-soluble radioactivity from organisms labeled by ^3H-thymidine. Cells were irradiated with a 15-W lamp at a distance of 45 cm; MMS treatment was with 0.3 M MMS for 5 min. The extent and rate of DNA breakdown was greater when postirradiation incubation was carried out in a complete medium that contained glucose than when incubation was carried out in a salts solution. Addition of amino acids or thymidine to the glucose medium reduced the amount of breakdown observed. Breakdown of DNA occurred after treatment with MMS and was dependent on the presence of glucose; the breakdown was not as extensive as that obtained with uv radiation to an equivalent lethality. It was concluded that glucose was required for uv-induced breakdown of DNA in B. subtilis and that the reaction was one that required energy. (B.H.S.)

39340 STUDIES OF THE FECAL EXCRETION OF THREE ^{51}Cr COMPLEXES BY NORMAL RATS AFTER ORAL ADMINISTRATION: SODIUM CHROMATE, CHROMIC CHLORIDE, AND ERYTHROCYTES LABELED WITH CHROMIUM. Desbuquois, B.; Cuisinier-Gleizes, P. (INSERM, Paris). Rev. Franc. Etud. Clin. Biol., 12: 375-9(Apr. 1967). (In French).

In order to select a nonabsorbable ^{51}Cr-labeled complex that could be used in metabolic balance studies with rats, the fecal recovery and transit times of three ^{51}Cr-labeled complexes: chromic chloride, Cr-labeled erythrocytes, and sodium chromate were determined. Fecal excretion of the three complexes took place mainly between the eighth and forty-eighth hour following ingestion; their transit times were statistically equal. Fecal recovery of chromic chloride and Cr-labeled erythrocytes was virtually complete within four days; this was not the case for sodium chromate. Results indicated that chromic chloride and Cr-labeled erythrocytes can be used as nonabsorbable indicators in the rat. (B.H.S.)

39341 BEHAVIOR OF ALKALINE PHOSPHATASE IN ZONULAR PARTS OF CILIAR PROCESSES AFTER IRRADIATION WITH A SOURCE OF ^{60}Co. Micali, A.; Genovesi, E. (Univ., Messina, Italy). Med. Nucl. Radiobiol. Lat., 9: 521-35 (1966). (In Italian).

A study was made of the variations of the alkaline phosphatase activity in the zonular part of the ciliary processes in some groups of albino rabbits that were irradiated with single doses of 300, 600, 1500, 2100, or 3000 R of γ radiation. After 300 R, the gradient of phosphatase activity decreased from the ciliary epithelium to the stroma, whereas after 3000 R, the activity gradient decreased from the stromal tissues to the epithelium. Between these two extremes, the gradients of enzymatic activity presented intermediary values. The literature on the subject is reviewed, and the possible interpretations of the findings are discussed. (auth)

39342 OPTIMUM ISOTOPE RATIO IN DOUBLE TRACER STUDIES. Tanaka, E.; Iinuma, T. A.; Matsuoka, O. (National Inst. of Radiological Sciences, Chiba, Japan). Phys. Med. Biol., 12: 345-52(July 1967).

A general equation is deduced for finding optimum isotope ratios in double tracer experiments from the criterion of minimizing the statistical errors in the results. An application is described to the retention studies of isotopes in a biological system, where successive measurements need to be made and the statistical errors of the measurements are a function of time after the administration of the isotopes. An example is given of a whole-body retention study of $^{137}Cs-^{86}Rb$. (UK) (auth)

39343 INFLUENCE OF THE CALCIUM LEVEL IN THE DIET ON THE ACCUMULATION AND ELIMINATION OF ^{90}Sr IN YOUNG RATS IN CHRONIC EXPERIMENTS. Annenkov, B. N. Radiobiologiya, 6: 622-3(1966). (In Russian).

The principles of the accumulation and elimination of ^{90}Sr and the influence of the level of Ca nutrition upon these processes were studied in young rats of the Wistar line. The rats were fed a diet that contained 0.3% Ca, or with a diet supplemented with calcium carbonate or bone ash (2.0% Ca). Strontium-90 was administered either perorally (0.36 μCi twice a week) or intraperitoneally (3.15 μCi/rat); in all cases the ^{90}Sr was administered 10 days after feeding of the test diet. Maximum accumulation was observed by the 100 to 150th day of administration of Sr, and ranged from 30.3 in the control group to 9.5 and 6.5 in the animals fed Ca-enriched diets. Exponential functions were derived empirically for the elimination of the radioisotope from the skeleton; significant differences were observed only for the readily exchanged fractions of ^{90}Sr and only between the control group and the group fed the calcium carbonate-enriched diet. There was no indication of the causes of the differences in the effect of bone ash and calcium carbonate upon the elimination of ^{90}Sr from the skeleton. (JPRS)

39344 INTERRELATIONSHIP OF STRONTIUM AND CALCIUM IN THE CASE OF THEIR PENETRATION INTO THE SKELETONS OF DOGS FROM THE FOOD. Dobryakova, G. V.; Panchenko, I. Ya.; Povalyaev, A. P. Radiobiologiya, 6: 625-7 (1966). (In Russian).

The deposition of ^{90}Sr in the animal skeleton was investigated in 22 mongrel male dogs at various absolute levels of Sr in the diet, but maintaining the same ratio between ^{90}Sr and Ca. The experiment was preceded by a month preliminary period, in which the animals received a diet with a small excess of Ca (up to 2 g/day) and higher caloric value, thus equalizing the general and mineral metabolism in all the animals. Systematic observations were made of the condition of the animals and the ^{90}Sr and Ca content in the diet and excreta. Animals were sacrificed after 30, 90, and 180 days, and samples of the bones, blood, diet, excreta, and soft tissues were collected for radiometric and chemical analyses. Strontium-90 and Ca (in the form of bone meal from the bones of animals that received ^{90}Sr for a long time) were administered in daily doses of 4.4×10^{-9} Ci of ^{90}Sr with 1 g Ca, or 4.4×10^{-8} Ci ^{90}Sr with 10 g Ca. The assimilation of Ca and Sr in the dogs of groups I and II differed by only 50 to 100%; a 100% difference was noted in the deposition of ^{90}Sr in the skeletons of dogs of groups I and II, despite the 10-fold difference in the ^{90}Sr contents in the diets. No significant difference was established in the Ca contents in the blood and bones of the dogs of groups I and II; nor was there any calcification of the soft tissues in the dogs of II. It was concluded that the assimilation of ^{90}Sr obeys the same principles as that of Ca; the two are assimilated from the gastrointestinal tract and accumulated in the skeleton in a definite ratio that is dependent upon their ratio in the diet. (JPRS)

39345 BIOCHEMICAL LESIONS INDUCED IN SUBCELLULAR STRUCTURES BY IONIZING RADIATION. IV. THE ACTIVITY OF PHOSPHOGLUCOMUTASE, PORPHOBILINOGEN SYNTHASE, AND FERROCHELATASE IN RAT LIVER AND SPLEEN. Dancewicz, Antoni M.; Panfil, Barbara (Inst. of Nuclear Research, Warsaw). Nukleonika, 12: 255-62(1967).

The activities of phosphoglucomutase, porphobilinogen synthase, and ferrochelatase were assayed in rat liver and spleen homogenates and in isolated subcellular fractions. Rats were exposed to a dose of 750 R of whole-body x irradiation. The assays were performed 0, 2, and 24 hours after exposure. Whole-body irradiation of rats caused a small decrease in PGM activity, a larger one in PBG synthase, and a small increase in the ferrochelatase activity of liver homogenates. The activity of all three enzymes decreased in spleen homogenates 2 and 24 hours after exposure. Similar changes were found in specific activity of all three enzymes when assayed in soluble fractions. An increase was, however, noted in the mitochondrial fraction of the spleen in the case of PBG synthase and ferrochelatase, thus resulting in changes in distribution of these enzymes among all the four subcellular fractions. (auth)

39346 DOSE AND TIME-DEPENDENCE OF THE INHIBITORY EFFECTS OF IRRADIATED SUCROSE ON GERMINATION AND GROWTH OF POLLEN OF TROPAEOLUM MAJUS. Kesavan, P. C.; Swaminathan, M. S. (Indian Agricultural Research Inst., New Delhi). Radiat. Bot., 7: 269-72(1967).

The effects of sucrose irradiated with 0.5 to 3 Mrad of γ-rays and stored for different durations were studied in Tropaeolum majus, using the germination and tube growth of pollen as indices. The extent of the inhibitory effect increased with dosage and was either enhanced or reduced with storage, depending upon the initial dose. It appears possible that the radiolytic products of sucrose formed at different dosages may be qualitatively different. (auth) (UK)

39347 THE INFLUENCE OF LIMING OF GRASS ON THE SECRETION OF ^{90}Sr IN COW'S MILK. van den Hoek, J.; Binnerts, W. Tj. (Agricultural Univ., Wageningen, Netherlands). Atompraxis, 13: 307-10(July 1967).

The effect of supplementary calcium, applied to pasture, on ^{90}Sr secretion in milk was studied under normal management conditions. Two compounds, 140 and 200 kg Ca/ha were used and administered as $CaCO_3$. The average reduction on ^{90}Sr in milk was 33%; the effect became noticeable within 24 hours, maximal reduction was attained in 4 days. No effects were observed from different climatic conditions or from two compounds with different Ca content. Simplicity of application and effects observed made this method interesting in case of a contamination event. (auth)

39348 EFFECT OF NUCLEIC ACID PRECURSORS AND OF THEIR ANALOGS ON THE INDUCTION FROM PROVIRUS TO VIRUS BY IRRADIATION. Zgaga, Vera; Miletic, Branimir (Inst. Ruder Boskovic, Zagreb). Biol. Glas., 16: 13-19(1963). (In Croatian).

Nucleosides, purines, pyrimidines, and their analogs were tested for effects on the x-radioinduced mutations in the lysogenic bacterium Escherichia coli K12(λ). Uridine, 6-azouracil, and thiouracil affected the induction of phage from prophage and increased survival of irradiated bacteria. Chloramphenicol and 5-hydroxyuridine, decreased phage induction. (TSS)

39349 ANTIBODY SYNTHESIS IN VITRO. VI. MANIFEST AND LATENT FUNCTIONS OF INFORMATIONAL RNA IN SPLEEN CELLS. Jacherts, D. (Medizinische Hochschule, Hanover). Z. Med. Mikrobiol. Immunol., 152: 262-72(1966). (In German).

The effect of uv irradiation on the synthesis of antibody and informational RNA was studied in an in vitro system. When spleen cells from normal mice were exposed to an RNA preparation obtained from macrophages previously exposed to an antigenic stimulus, antibody synthesis was initiated. The resulting antibody was homologous to the antigen that stimulated the macrophages, and was a 19 S γ-globulins. The antibody synthesis was induced after a single contact of the spleen cells with the informationally active RNA and was continued for about 4 to 6 days. After this period antibody could not be detected in the cell culture supernatant or in cell extracts. During the period of antibody production an informationally active RNA could be demonstrated in the spleen cells. This RNA could be extracted from the cells; it was able to initiate antibody synthesis of the same specifity in a cell-free system. The informationally active RNA could not be demonstrated in the cells but only during the antibody production period. It was possible to maintain the cells after their antibody production period for about 2 weeks in a latent state. A single uv irradiation of the cells during the latent period activated the synthesis of informationally active RNA as well as the synthesis of antibody. The resulting antibody could be demonstrated in cell extracts; it could be distinguished from the antibody that was produced before the latent period. (BBB)

39350 A RATIONAL METHOD OF MEASUREMENT AND EVALUATION FOR THE DETERMINATION OF THE BIOLOGICAL HALF-LIFE OF RADIOISOTOPES AND ITS APPLICATION IN ENTOMOLOGY. Schlagbauer, Albert (Univ., Bonn). Int. J. Appl. Radiat. Isotopes, 18: 595-603(Aug. 1967). (In German).

Decay curves were determined from measurements of the pulse rate of radioactively labeled compounds on live insects by means of a FORTRAN 7090 computer programme. The biological half-lives were calculated therefrom on the basis of formulas that are given. An exact mathematical method with rational data processing gave reproducible results. The method was tested with various insects. Water bugs secreted the tracers used more quickly than bed bugs. For phosphate and iodide the biological half-life for bed bugs amounted to about 50 days and for water bugs, 3 days. For rubidium chloride, on the other hand, 50% was eliminated by the bed bugs within $1\frac{1}{2}$ days. (UK) (auth)

39351 EFFECT OF LOW AND HIGH CALCIUM INTAKE ON ^{90}Sr METABOLISM IN ADULT MAN. Spencer, Herta (Veterans Administration Hospital, Hines, Ill.); Samachson, Joseph; Hardy, Edward P. Jr.; Rivera, Joseph. Int. J. Appl. Radiat. Isotop., 18: 605-14(Aug. 1967).

Balances of ^{90}Sr was determined in man under constant dietary conditions during low and high calcium intake, but during a similar intake of ^{90}Sr. Ten patients were studied during low calcium intake (average 213 mg Ca/day) and 10 patients during high calcium intake (average 1718 mg Ca/day), the latter being attained by adding calcium gluconate tablets to the constant low calcium diet. The average ^{90}Sr intake was similar during low and high calcium intake, 4.6 pCi/day and 5.7 pCi/day, respectively. The average ^{90}Sr balance was slightly more negative during high calcium intake. There was no significant difference between the percent net absorption of ^{90}Sr during the intake of the low and high calcium diets, 12.3% versus 6.5% of the ^{90}Sr intake, respectively. The ^{90}Sr/Ca ratios of the diet, urine, and stool were determined and the Observed Ratios (O.R.) were calculated. The ^{90}Sr/Ca ratios of stool/diet were less variable than the ^{90}Sr/Ca ratios of urine/diet during the intake of different levels of calcium. Since the ^{90}Sr/Ca ratio of stool was similar to the ^{90}Sr/Ca ratio of the diet during both low and high calcium intake, the fecal ^{90}Sr/Ca ratio can be used for the estimation of the dietary ^{90}Sr intake. (UK) (auth)

39352 PHOTOALLERGIC CONTACT DERMATITIS DUE TO HALOGENATED SALICYLANILIDES AND RELATED COMPOUNDS. Harber, Leonard C.; Harris, Harriet; Baer, Rudolf L. (New York Univ., N. Y.). Arch. Dermatol., 94: 255-62(Sept. 1966).

Ultraviolet sensitivity studies were conducted in 5 patients showing photoallergic reactions to some antimicrobial agents commonly added to soaps (hexachlorophene, halogenated salicylanilides, and bithionol). These substances are all composed of a hydroxy-halogenated benzene ring cross-linked to a halogenated benzene ring which may or may not carry a hydroxyl group. Cross-photosensitivity was demonstrated between tetrachlorosalicylanilide, tribromosalicylanilide, and bithionol, but not with hexachlorophene. Ultraviolet light in the range of 2800 to 4500 Å was required for initiation of these photoallergic reactions. Histologically photoallergic contact dermatitis is identical with allergic contact dermatitis, but it is distinctly different from phototoxic contact dermatitis. Allergic contact sensitivity to some of these compounds may be present simultaneously with or without photoallergic contact sensitivity. The mechanism mediating photoallergic contact sensitivity to halogenated salicylanilides is proposed to be that uv light (3600 Å) causes the formation of a free-radical derivative which binds with cutaneous proteins. This new hapten-protein unit then acts as a photoantigen in a small percentage of the exposed population. (BBB)

39353 CYTOTOXICITY OF CARBOHYDRATES HEAVILY IRRADIATED IN SOLUTION. Hills, P. R. (Atomic Energy Research Establishment, Wantage, Eng.); Berry, R. J. Nature (London), 215: 309(July 15, 1967).

Heavily irradiated solutions of carbohydrates have been shown to influence the growth of bacterial cultures, and plant and animal cells, and to produce chromosome abnormalities in mammalian cells. Sodium formate has been isolated from irradiated sucrose solution and shown to suppress the growth of carrot phloem explants. The present authors concluded that the compound most likely to account for the persistent toxicity of the irradiated solutions is glyoxal. Formaldehyde is present in irradiated carbohydrate solutions, but it is unlikely that it is directly cytotoxic. It has been suggested that formic acid, from the oxidation of

formaldehyde, which might occur during irradiation or in the culture medium, results in the development of cytotoxicity. Glyoxal might similarly be converted to oxalic acid, which may be suspected as a potential cytotoxic agent. Since oxalic and formic acids are interconvertible the gross effect of irradiated carbohydrate solutions might be accounted for by the system formaldehyde → formic acid ⇌ oxalic acid ← glyoxal. The present paper describes a study to test this hypothesis, employing a culture medium in which mouse fibroblasts were grown. It was found that sodium formate exerted no cytotoxic effect. Sodium oxalate was much less cytotoxic than glyoxal. It was concluded that oxidative processes involving the formation of formic and oxalic acids from formaldehyde and glyoxal cannot be expected to contribute to the cytotoxicity of heavily irradiated carbohydrate solutions. The glucose solution used in these studies was shown to retain its cytotoxicity for more than 2 years after irradiation. (UK)

39354 OBSERVATIONS ON THE ATTACHMENT OF ^{51}Cr TO THE HUMAN RED CELL. Carter, Bettina B.; Jackson, D. F.; Kolber, A. R. (Univ. of Louisville, Ky.). Int. J. Appl. Radiat. Isotop., 18: 615-18(Aug. 1967).

Radiochromium attachment to the human red cell was reported to occur at the globin portion of the chromoprotein. Investigation showed no activity in carbohydrate or lipid fractions of the red cell, but demonstrated radioactivity of 13% per gram of heme. (UK) (auth)

39355 THE QUESTION OF STRONTIUM AND CALCIUM METABOLISM IN MAN. Dubrovina, Z. V.; Sarapul'tsev, I. A.; Fadeev, A. P. Gig. Sanit., No. 4, 43-6(Apr. 1967). (In Russian).

The stable strontium and calcium balance was studied in adult persons under normal conditions. A correlation was carried out between the balances of these elements in the body and their content in the food. The finding was that a zero balance of calcium was obtained when it was introduced into the body in an amount of 600 to 700 mg/day. The retention of calcium and strontium in the body depended on their concentration in the food ration and was expressed by an identical ratio with exceedingly close values. Certain parameters peculiar to stable strontium metabolism in man were determined. (auth)

39356 STRYCHNINE AND ADRENAL HORMONE EFFECT ON ^{32}P UPTAKE IN THE THYMUS OF WHITE RATS. Balan, Lucia; Muresan, I. Stud. Univ. Babes-Bolyai, Ser. Biol., No. 2, 139-41(1965). (In Romanian).

The experiments were performed on eight groups of female white rats: controls; animals receiving daily hydrocortisone doses of 15 mg per 100 g body weight, during 3 days; animals receiving daily ACTH doses of 15 I.U. for 3 days; adrenalectomized animals kept alive on a high sodium diet for 9 days; animals to which daily strychnine doses of 0.02 mg per 100 g body weight were administered; animals given 0.02 mg strychnine and hydrocortisone; 0.02 mg strychnine and ACTH-treated animals; and adrenalectomized animals given a single strychnine dose of 0.02 mg on the 7th postoperative day. After 3 days of management as shown above, all animals were given 3.5μ of ^{32}P per 100 g. After sacrifice, radioactivity was determined in the thymus and spleen. Results indicated that the total amount of hydrocortisone 45 mg/100 g given during 3 days, diminished ^{32}P uptake by 44% in the thymus; the administration of 45 I.U. ACTH brought about a 25% decrease; bilateral adrenalectomy increased ^{32}P uptake by 16% as related to the means recorded in controls; hormonal therapy associated with strychnine administration did not modify ^{32}P uptake in the thymus and spleen relative to cortisone or ACTH-treated animals, or to the adrenalectomized ones; strychnine administration did not induce any changes either in the weight or ^{32}P uptake in the thymus. (TSS)

39357 ON ^{32}P UPTAKE IN THE BODY OF SOME BLACK SEA FISHES. Serbanescu, O.; Jitaru, P. An. Stiint. Univ. Al. I. Cuza, Iasi, Sect. IIa, 11: No. 1, 7-12(1965). (In Romanian).

Investigations on the uptake of ^{32}P in fishes were performed on the species Gobius cephalarges and Sprattus sprattus phalericus. Two experimental procedures were used. Glass aquariums containing sea water with a solution of $Na_2{}^{32}PO_4$ added to a water radioactivity of 8.7 were used. The fishes were kept in the radioactive water for a maximum of 168 hours. At various intervals, 2 to 9 animals were sacrificed and radioactivity was determined in some of the organs. Fishes receiving ^{32}P in intramuscular injections of 12.6 mc were sacrificed after 48 hours for autoradiogram studies. The first experiments showed that ^{32}P uptake from sea water varied with the natural, bentonic, or pelagic environment of the animals. (TSS)

39358 EFFECT OF IONIZING X-RAYS ON THE HISTOCHEMICAL REACTIONS IN THE ADRENALS OF RATS. Brzezinski, Ryszard (Akademia Medyczna, Poznan, Poland). Endokrynol. Pol., 17: 307-20(May-June 1966). (In Polish).

Whole-body doses of 700 and 1200 R of x rays were given to rats. Rats of both groups showed pathologic changes in the cell nuclei of the adrenal cortex. The changes included peripheral displacement of chromatin and nucleoli, degeneration (pycnosis and karyolysis), and reduction in the amount of paranucleolar material. The observed marked increase in phospholipid content of zona fasciculata cells that followed irradiation might reflect a release of these compounds from damaged mitochondria and Golgi apparatus. In response to doses of 700 and 1200 R, histochemical reactions for lipids and steroids containing α-keto groups decreased in all adrenal cortical zones. Irradiation induced swelling and distintegration of the mitochondria, involution of Golgi apparatus, and increased permeability of the lysosome membranes. The x-ray doses used reduced the activity of acid phosphatase and caused its displacement toward the cell periphery. In both groups, adrenal activity of acid phosphatase was slightly higher than control; the greatest rise in the activity was observed within the zona arcuata. Following irradiation with both doses, reactions for ATPase and DNase II decreased. Alterations of reactions for lipids and steroids containing α-keto groups in the irradiated animals indicated regressive changes in the adrenal cortex, particularly in rats receiving 1200 R. (BBB)

39359 QUANTITATIVE RESPONSE OF NEURONS TO X IRRADIATION: TOTAL ORGANIC MASS, SUCCINOXIDASE ACTIVITY, POTASSIUM PERMEABILITY, AND RNA CONTENT IN ISOLATED CELLS. Hallen, Olle; Hamberger, Anders; Rosengren, Bengt; Roeckert, Hans (Univ. of Goteborg). J. Neuropathol. Exp. Neurol., 26: 327-34(Apr. 1967).

Chemical events were studied in nerve cells during the acute (first weeks) reaction to ionizing radiation, before any morphological changes were present. The brain stem area of rabbits was exposed to a single dose of x irradiation (2000 or 3000 R). The animals were killed at intervals ranging from three hr to three weeks after irradiation. Total organic material, RNA content, succinoxidase activity, and K^+ content were analyzed on isolated nerve cells from the lateral vestibular nucleus. A rapid increase in mass, RNA, and succinoxidase was observed within 24 hr. After a return towards control values a second and more impressive increase occurred about one week after irradiation. The permeability for K^+ was increased during the whole period and showed no biphasic response. The mechanism of the cellular response is discussed in relation to other types of cell stimulation and the primary-secondary effects are considered. Correlation of K^+ permeability with mass, RNA, and succinoxidase data may indicate that hypertrophy of the energy transducing apparatus is necessary to keep an acceptable ionic ratio during periods of unfavorable membrane permeability. (BBB)

39360 ACTION OF SOME FOREIGN CATIONS AND ANIONS ON THE CHLORIDE PERMEABILITY OF FROG MUSCLE. Hutter, O. F.; Warner, Anne E. (National Inst. for Medical Research, London). J. Physiol. (London), 189: 445-60(Apr. 1967).

Effects of uranyl, some rare earth metal, and other cations on ^{36}Cl, ^{82}Br, and ^{131}I efflux from frog muscle equilibrated in high concentration KCl solutions were studied to obtain evidence for the existence in skeletal muscle of a specific cation binding system capable of lowering the halide ion permeability. It was shown that Cu^{2+}, Zn^{2+}, and UO_2^{2+} ions, when present in concentrations of $\sim 10^{-4}$M in inactive wash solution at pH 7.4 slowed the efflux of ^{36}Cl to half its original value. At pH 5.0, when the Cl permeability was already low as a consequence of H^+ ion binding, these metal ions had little further effect. The presence of Ni^{2+}, Co^{2+}, Pb^{2+}, Ce^{3+}, and La^{3+} in 10^{-4}M or higher concentrations had no detectable influence on the ^{36}Cl efflux. Wide variations in Ca^{2+} concentration were similarly ineffective. The influence of more absorbable anions of Cl permeability was examined at different pH values. Extracellular iodide greatly slowed the rapid efflux of ^{36}Cl into alkaline solution. In acid solutions, when the Cl permeability was already low, the effect of I was less pronounced, but still demonstrable. Chloride permeability was consequently increased to a lesser extent by a rise in pH in the presence of I ion. Efflux of ^{82}Br and ^{131}I ion was measured at different pH values under conditions of self exchange. In alkaline solution the permeabilities to ^{82}Br and ^{131}I were considerably lower than that to ^{36}Cl. In acid solution, the membrane differentiated less between anion species of different adsorbability. (BBB)

39361 SIMULTANEOUS INTESTINAL TRANSFER OF D- AND L-METHIONINE IN IRRADIATED RABBITS. Mehran, A. R.; Blais, R. (Laval Univ., Quebec). Arch. Int. Physiol. Biochim., 75: 27-35(1967).

Results of an earlier in vivo study showed that intestinal transfer of L-alanine in irradiated rabbits was not affected by doses of 300 and 600 R as determined four days after irradiation. A comparative study was made of the intestinal transfer of D- and L-methionine and of one phase of their metabolism in control rabbits and in

rabbits tested 24 hr after having been exposed to 800 R of whole-body irradiation from a ^{137}Cs source at the rate of 4.1 R/min. The simultaneous intestinal transfer of D- and L-methionine was studied in vivo by use of labeled D-methionine (methyl ^{14}C) and L-methionine (methyl ^{3}H). Following the duodenal injection of the isomers, the radioactivity was measured in both femoral and portal sera at regular intervals. The curve so obtained showed a very rapid intestinal transfer of these amino acids and no difference was observed between irradiated and unirradiated animals. However, a marked change in the metabolic fate of the L-methionine was observed in irradiated rabbits. Serum proteins of the irradiated animals showed a higher level of radioactivity than that of the controls, suggesting a more active protein synthesis in irradiated rabbits. (BBB)

39362 RADIATION PHYSICS IN RADIOLOGY. Oliver, R. Oxford, Blackwell Scientific Publications, 1966. 120p. 22s. 6d.

An account is given of the following topics: atomic structure, production of x-rays, absorption of energy from x-radiation, mechanisms of x-ray absorption, measurement of x-radiation, radioactivity, protection of staff and patients, visible light and physical optics. (UK)

Ecology

Refer also to abstracts 39321, 39436, and 40745.

39363 (BMI-171-003) BIOENVIRONMENTAL AND RADIOLOGICAL-SAFETY FEASIBILITY STUDIES ATLANTIC–PACIFIC INTEROCEANIC CANAL. (Battelle Memorial Inst., Columbus, Ohio). Jan. 13, 1967. Contract AT(26-1)-171. 102p. Dep. CFSTI.

A detailed outline is presented of the parameters to be used in the compilation and evaluation of data on the biology and ecology of the coastal and land areas of Colombia and Panama that are designated for the Atlantic-Pacific Interoceanic Canal; identification of the organisms of potential major importance as sources of radioisotope exposure to man during and after the proposed excavation; and identification of information voids that appear to require further field data collection on the biology and ecology of critical organisms. Areas included in the study are agricultural ecology, estuarine and marine ecology (specific activity approach), freshwater ecology, human ecology, hydrology, and radioisotope distribution, marine ecology and resources, physicochemical oceanography, and terrestrial ecology. (B.H.S.)

39364 (BMI-171-005) BIOENVIRONMENTAL AND RADIOLOGICAL-SAFETY FEASIBILITY STUDIES ATLANTIC–PACIFIC INTEROCEANIC CANAL. MARINE RESOURCES AND ECOLOGY. Phase I Final Report. Voss, Gilbert L. (Miami Univ., Fla. Inst. of Marine Science). Mar. 6, 1967. Contract AT(26-1)-171. 143p. Dep. CFSTI.

For Battelle Memorial Inst., Columbus, Ohio.

A compilation of the collected and existing data is presented on the marine biology and ecology of the coastal areas of Colombia and Panama that are designated for the Atlantic-Pacific Interoceanic Canal; the marine organisms identified that are of potential major importance as sources of radioisotope exposure to man during and after the proposed excavation; and the methods used in evaluation of the data. (B.H.S.)

39365 (BMI-171-006) BIOENVIRONMENTAL AND RADIOLOGICAL-SAFETY FEASIBILITY STUDIES ATLANTIC–PACIFIC INTEROCEANIC CANAL. HUMAN ECOLOGY STUDIES, PANAMA. Phase I Final Report. de Arauz, Reina Torres (Battelle Memorial Inst., Columbus, Ohio). Mar. 28, 1967. Contract AT-(26-1)-171. 131p. Dep. CFSTI.

The literature on the cultural, demographic, and ecological characteristics of regions in Panama that are designated for the Atlantic-Pacific Interoceanic Canal is reviewed. Detailed information is presented on: population and demographic aspects; cultural aspects; Cuna Indians, Choco Indians, Negroes and mestizoes and colonists originating from the western part of Panama; economic aspects; land occupancy; political divisions and reservations; educational aspects; and sanitary aspects. (B.H.S.)

39366 (BMI-171-007) BIOENVIRONMENTAL AND RADIOLOGICAL-SAFETY FEASIBILITY STUDIES ATLANTIC–PACIFIC INTEROCEANIC CANAL. ESTUARINE AND MARINE ECOLOGY. Phase I Final Report. Lowman, Frank G. (Puerto Rico Nuclear Center, Mayaguez). Mar. 29, 1967. Contract AT(26-1)-171. 86p. Dep. CFSTI.

For Battelle Memorial Inst., Columbus, Ohio.

The maximum permissible concentration (MPC) approach was used to develop relative significance indexes (RSI) for the radioisotopes that would be produced if nuclear explosives were used to excavate the channel of the proposed Atlantic-Pacific Interoceanary Canal. The RSI will be used as a basis for evaluating relative hazards from field measurements. The sampling programs for the specific-activity survey on the marine environment, marine organisms, and runoff water from the land are outlined in detail. (B.H.S.)

39367 (BMI-171-008) BIOENVIRONMENTAL AND RADIOLOGICAL-SAFETY FEASIBILITY STUDIES ATLANTIC–PACIFIC INTEROCEANIC CANAL. FRESHWATER ECOLOGY. Phase I Final Report. Templeton, William L.; (and others) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 14, 1967. Contract AT(26-1)-171. 121p. Dep. CFSTI.

For Battelle Memorial Inst., Columbus, Ohio.

Data pertinent to the freshwater ecology of the land areas of Colombia and Panama that are designated for the Atlantic-Pacific Interoceanic Canal are presented. Methods and procedures that will be used in analysis and collection of additional data on the freshwater ecology of these regions are outlined and discussed. (B.H.S.)

39368 (BMI-171-009) BIOENVIRONMENTAL AND RADIOLOGICAL-SAFETY FEASIBILITY STUDIES ATLANTIC–PACIFIC INTEROCEANIC CANAL. A NOTE ON THE ORIGIN OF EXPONENTIAL FUNCTIONS IN MODELS TO DESCRIBE THE TRANSFER OF RADIONUCLIDES THROUGH AN ECOSYSTEM. Bloom, S. G.; Raines, G. E. (Battelle Memorial Inst., Columbus, Ohio). Apr. 3, 1967. Contract AT(26-1)-171. 10p. Dep. CFSTI.

Starting with a general, theoretical model for the transfer of radioisotopes through an ecosystem, an analytical solution is obtained for the resulting set of differential equations under the assumption of unidirectional flow and transfer coefficients independent of radioisotope concentration. With the further assumptions that the transfer coefficients are constants and that the source term is either a pulse, step, or exponential function of time, the solution is reduced to sums of exponential functions. Expanded solutions are given for a four-compartment model with constant transfer coefficients and a pulse function source and a two-compartment model with one periodic transfer coefficient and an exponential function source. (auth)

39369 (BMI-171-010) BIOENVIRONMENTAL AND RADIOLOGICAL-SAFETY FEASIBILITY STUDIES ATLANTIC–PACIFIC INTEROCEANIC CANAL. AGRICULTURAL ECOLOGY. Phase I Final Report. Gamble, John F.; Popenoe, Hugh; (and others) (Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences). Apr. 14, 1967. Contract AT(26-1)-171. 40p. plus Maps. Dep. CFSTI.

For Battelle Memorial Inst., Columbus, Ohio.

Data pertinent to the agricultural ecology of the land areas of Colombia and Panama that are designated for the Atlantic-Pacific Interoceanic Canal are presented. Methods and procedures that will be used in analysis and collection of additional data on the agricultural ecology of these regions are outlined and discussed. (B.H.S.)

39370 (BMI-171-011) BIOENVIRONMENTAL AND RADIOLOGICAL-SAFETY FEASIBILITY STUDIES ATLANTIC–PACIFIC INTEROCEANIC CANAL. TERRESTRIAL ECOLOGY. Phase I Final Report. McGinnis, John T.; Golley, Frank B.; (and others) (Georgia Univ., Athens. Inst. of Radiation Ecology). Apr. 19, 1967. Contract AT(26-1)-171. 114p. Dep. CFSTI.

For Battelle Memorial Inst., Columbus, Ohio.

A compilation of the data is presented on the terrestrial biology and ecology of the land areas of Colombia and Panama that are designated for the Atlantic-Pacific Interoceanic Canal; the terrestrial organisms identified that are of potential major importance as sources of radioisotope exposure to man during and after the proposed exposure to man during and after the proposed excavation; and the methods used in evaluation of the data. (B.H.S.)

39371 (ORNL-TM-1910) ACCUMULATION AND CYCLING OF CALCIUM BY FLOWERING DOGWOOD TREES. Thomas, W. A.; Auerbach, S. I.; Olson, J. S. (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 153p. Dep. CFSTI.

Thesis. Submitted to Univ. of Minnesota, Minneapolis.

The influence of flowering dogwood (Cornus florida L.) trees on the distribution of calcium in forest stands was investigated. The two primary objectives of the investigation were to document the accumulation of calcium by various organs of the plant and to determine the rate of calcium circulation in the tree-soil system. (B.H.S.)

39372 (ORO-3299-7) EFFECTS OF IONIZING RADIATION ON SEEDLING DIVERSITY AND ABUNDANCE IN A TROPICAL FOREST. McCormick, J. Frank (North Carolina Univ., Chapel

Hill. Dept. of Botany). May 1967. Contract AT(40-1)-3299-7. 27p. (CONF-660833-1). Dep. CFSTI.

From Annual Meeting on American Institute of Biological Science, College Park, Md.

The tropical rain forest was less radiation sensitive than temperate forests that were studied; recovery appeared to be faster. Prior to irradiation vegetation trampling by ecologists studying the forest decreased seedling density and thereby reduced species diversity. Following irradiation, as more radiation sensitive species disappeared, species diversity was reduced in proportion to the radiation exposure. Seedling density increased in an area that received a dose in excess of 35 kR. These populations initially consisted of a single species, Palicourea riperia, that flourished in response to microenvironmental changes rather than radiation exposures. (auth)

39373 (RLO-1750-22(Vol.1)) ECOLOGICAL STUDIES OF RADIOACTIVITY IN THE COLUMBIA RIVER AND ADJACENT PACIFIC OCEAN. Progress Report, July 1, 1966-June 30, 1967. McCauley, James E. (comp. and ed.) (Oregon State Univ., Corvallis. Dept. of Oceanography). July 1967. Contract AT(45-1)-1750. 356p. Dep. CFSTI.

FOOD CHAINS, ECOSYSTEMS—radioisotope distribution of Columbia River estuary
SEA WATER—radioisotope distribution of Columbia River estuary and adjacent Pacific Ocean
SILTS—radioistope distribution of Columbia River estuary
PHOSPHORUS-32, MANGANESE-54, ZINC-65, COBALT-60—distribution in biota, sediments, and water in Columbia River estuary
COLUMBIA RIVER—radioisotope distribution in biota, sediments, and water in
FISH—zinc-65 content of, in Columbia River and estuary; manganese-54 content of, in Columbia River and estuary; cesium-137 content of, in Columbia River and estuary
PLANKTON—ecology in Columbia River estuary
ZINC-65, CHROMIUM-51—distribution in food chains of Columbia River Estuary
CRUSTACEANS—zinc-65 distribution in tissues of Cancer magister; chromium-51 distribution in tissues of Cancer magister; manganese-54 distribution in tissues of Cancer magister
RADIOISOTOPES—separation from sea water, precipitation methods for
SEA WATER—radioisotope separation from, precipitation methods for
GAMMA SPECTROSCOPY—sample preparation of sea water for
SEA WATER—radioisotopes in, sample preparation for γ spectroscopy of
PACIFIC OCEAN—flow of Columbia River winter plume in, chromium-51 tracer study of
COLUMBIA RIVER—flow of winter plume of, in Pacific Ocean, chromium-51 tracer study of
COLUMBIA RIVER—measurements of flow time of, tracer study of
ZINC—determination in sea water
SEA WATER—zinc determination in
ZINC—distribution in marine organisms
ORGANIC ACIDS—determination in sea water by gas chromatography
SEA WATER—analysis for organic acids in, using gas chromatography
PACIFIC OCEAN—chemical composition of water in, effects of Columbia River effluent on
COLUMBIA RIVER—effects on chemical composition of Pacific Ocean off Oregon coast
CRUSTACEANS—radiation effects on reproduction of Artemia, γ
GAMMA RADIATION—effects on reproduction of Artemia
ECHINODERMS—zinc-65 distribution in tissues of starfish, effects of feeding habits, on
ZINC-65—content of starfish in Pacific coast, effects of filter-feeding mussels on diet on
IRON-55—content in Pacific Ocean salmon
FISH—iron-55 content in Pacific Ocean salmon, effects of fallout on
LEAD-210, POLONIUM-210—content in fish used for food, naturally occurring
FISH—lead-210 content of, used for food by man
FISH—polonium-210 content of, used for food by man
MOLLUSKS—zinc-65 content of Mytilus californianus along Pacific coast
ZINC-65—content of mussels along Pacific coast
INVERTEBRATES—effects on distribution of radioisotopes in food chains, ecological factors affecting
ECHINODERMS, FISH, CRUSTACEANS, MOLLUSKS—effects on distribution of radioisotopes in food chains, ecological factors affecting
PACIFIC OCEAN—animals in northeast, ecology of (C.H.)

39374 (TID-23858(Pt.9)) PHENOLOGICAL INVESTIGATIONS OF NEOTOMA OPEN VALLEY BOTTOM OLD-FIELD VASCULAR PLANT SPECIES. Final Report, Part IX. Naskali, Richard J. (Ohio State Univ., Columbus. Dept. of Botany and Plant Pathology). 1967. Contract AT(11-1)-552. 185p. Dep. CFSTI.

Various aspects of growth and reproduction of 188 species of vascular plants were observed between July 1, 1959, and December 31, 1961. All observations were limited to the old-field open valley bottom of Neotoma, a small valley in Hocking County, Ohio. One to five permanently labeled individuals of each species were observed. Complex interactions of environmental factors and critical daylengths, flower bud initiation times, swelling of buds, onset and cessation of stem elongation, stem and leaf senescence, and many other aspects of plant ontogeny were evident. The following classification of seasons with the biotic events in an old field is proposed: Spring (February 27 to May 17) begins with the renewal of herbaceous stem elongation and swelling and breaking of buds of woody species. Flowering begins in most individuals of species in which flower bud initiation was started or completed during the previous growing season. Resumption of shoot elongation occurs in over 80% of the herbaceous species included here. Summer (May 17 to September 6) begins with the flowering of long-day plants. Stem elongation ceases in all woody species. During late summer, the greatest number of species reach flowering and the first autumnal coloration occurs in a few woody species. Onset of autumn (September 6 to November 26) occurs with the first autumnal coloration of leaves of many woody species. Numerous short-day herbaceous species reach flowering. Woody plant leaf abscission and aerial stem senescence in herbaceous species characterize the autumn. Winter (November 26 to February 27) ensues with the cessation of flowering in herbs and the onset of leaflessness in woody deciduous species. Winter ends with the first swelling of woody plant buds and the onset of herbaceous stem elongation. (H.L.W.)

39375 (UCRL-70301) BIOLOGICAL AVAILABILITY OF RADIONUCLIDES IN FALLOUT FROM THE CHINESE NUCLEAR TEST OF DECEMBER 1966. Potter, Gilbert D.; McIntyre, David R.; Pomeroy, Deborah (California Univ., Livermore. Lawrence Radiation Lab.). May 12, 1967. Contract W-7405-eng-48. 14p. (CONF-670503-22). Dep. CFSTI.

From 2nd National Symposium on Radioecology, Ann Arbor, Mich.

The Chinese nuclear test of December 28, 1966, deposited fallout in northern California on January 1 and 2, 1967. The transfer of radionuclides in dry fallout from pasture grass to cows milk was studied with a lithium-drifted germanium detector. The radionuclides on the grass and in the milk were identified and specific nuclides were quantitated from the resulting gamma spectra. The particular family cow that was observed was probably a worst-case situation for dry fallout in that all of the nutritional requirements of this cow were derived from a small pasture. It is estimated that the observed value of the ^{131}I in the milk of this cow, 1,000 pCi of ^{131}I, could have been higher by a factor of as much as 200 had this been a rainout. This would have exceeded the FRC recommendation for a single event contamination by a factor of about five. The new solid state lithium-drifted germanium detector is a valuable tool for radioecology studies. (auth)

Genetics and Cytogenetics

Refer also to abstracts 39348 and 39534-39536.

39376 (BNL-11515) RECOVERY OF MAMMALIAN CHROMOSOMES FROM RADIATION INJURY. Curtis, Howard J. (Brookhaven National Lab., Upton, N. Y.). [1967]. 23p. (CONF-670632-1). Dep. CFSTI.

From Symposium on Recovery and Repair Mechanisms in Radiobiology, Upton, N. Y.

Two recovery mechanisms are proposed. The first is the elimination of genetic damage by cell selection at the time of cell division. The cells carrying mutations are assumed to be less likely to survive cell division than are the normal cells. This repair process is very important in acute effects, but it probably plays no part in recovery from long-term effects. The second process is called nuclear repair, and it may apply either to chromosome breaks or to point mutations. It is estimated that at least 75% of chromosome breaks can be repaired within hours of a small dose of γ rays. Following this, cell selection and slow chromosomal

repair can overcome much of the residual damage. Point mutations are assumed to be caused by multiple hits. They are repairable as long as they exist as incipient damage only, but not after they become fully-formed point mutations. The point mutations are the likely cause of delayed effects of radiation. (W.E.B.)

39377 (K-DP-1711) FRUIT FLY MUTANT DATA STORAGE AND RETRIEVAL SYSTEM. Price, C. E. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Aug. 8, 1966. Contract W-7405-eng-26. 27p. (CONF-670633-1). Dep. CFSTI.

From the Association for Computing Machinery Conference, Chapel Hill, N. C.

A computer-based system is described that maintains a master data file on Drosophila melanogaster mutants and that can provide output lists in various arrangements. More than 9000 mutants are on file. Flow charts are given, and the program phases are described in detail. The programs are written in the COBOL language with some MAP routines for the IBM 7090/7094 and 1401 computers. (W.E.B.)

39378 (ORNL-P-3201) EFFECTS OF RADIATION ON CHROMOSOMES. Bender, Michael A. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 46p. (CONF-670709-2). Dep. CFSTI.

From Symposium on Peaceful Uses of Atomic Radiation, Rio de Janeiro, Brazil.

Data are reviewed from studies on the effects of acute or chronic exposure to γ or x radiation on the induction of breakage in human chromosomes and recombination after radioinduced breaks. Topics discussed include dose-effect kinetics, factors modifying aberration yields, recovery and repair processes, and the fates of aberrations and of the cells containing them. Emphasis is placed on results of studies on cultured human leukocytes since this is the best system available for laboratory studies. Results are also reviewed from studies on cells from patients irradiated for therapeutic reasons and studies on irradiated human populations. The use of chromosome analyses on leukocyte samples for biological dosimetry is discussed briefly. (65 references) (C.H.)

39379 (ORNL-P-3250) DOSE-RATE EFFECTS ON INACTIVATION AND MUTATION-INDUCTION IN NEUROSPORA CRASSA. de Serres, F. J.; Malling, H. V.; Webber, B. B. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 32p. (CONF-670632-2). Dep. CFSTI.

From Symposium on Recovery and Repair Mechanisms in Radiobiology, Upton, N. Y.

A comparison was made of the effect of reduction in the rate of x-ray exposures from 1000 to 10 R/min at room temperature on inactivation of heterokaryotic conidia and the induction of recessive lethal mutations at specific loci with a heterokaryon of Neurospora crassa. Higher levels of survival of the heterokaryotic conidia were found with 10 R/min exposures than with 1000 R/min exposures. The dose-reduction factor was about 2.5. It was concluded that the x-ray-induced lesions that produced point mutation at specific loci were qualitatively different from the lesions that produced chromosome breakage and that a variety of repair mechanisms, operating at either the cytoplasmic or nuclear level, existed in Neurospora. (B.H.S.)

39380 (ORO-3028-5) COMBINING ABILITY AND THE EFFECT OF IRRADIATION UPON HETEROSIS AMONG DIVERSE POLYGENIC SYSTEMS IN OATS. Progress Report, November 15, 1966-August 14, 1967. Murphy, Charles F. (North Carolina State Univ., Raleigh). Contract AT(40-1)-3028. 7p. Dep. CFSTI.

Progress is reported on studies on the effects of radiation on heterosis among diverse polygenic systems in oats (Avena sativa). Fifteen oat lines were crossed and 84 combinations were obtained. Data on plants through the F4 generation were collected. No results are reported. (C.H.)

39381 (ORO-3297-3) THE LATE EFFECTS OF ^{90}Sr IN THE MONKEY: STUDIES OF CARCINOGENIC, LEUKEMOGENIC, AND CYTOGENETIC CHANGES. MECHANISMS OF CARCINOGENESIS AND RADIATION INJURY. Progress Report No. 3, October 1, 1964-June 30, 1967. Tuttle, Lawrence W.; Parrot, Marshall W. (Tulane Univ., Covington, La. Delta Regional Primate Research Center). Contract AT(40-1)-3297. 27p. Dep. CFSTI.

Progress is reported on the following studies: chromosome aberrations in peripheral lymphocytes of Macaca mulatta chronically irradiated with ^{90}Sr; roentgenographic skeletal changes in Macaca mulatta chronically irradiated with ^{90}Sr; increase in white blood cells at early time intervals following ^{60}Co irradiation of the rhesus monkey; retention and milk transfer of ingested ^{90}Sr in the rhesus monkey; chromosome aberrations in the granulocytic marrow cells of Macaca mulatta chronically irradiated with ^{90}Sr. In Macaca mulatta exposed to 210 R of whole-body ^{60}Co, chromosome aberrations appeared in peripheral lymphocytes as early as 5 min after exposure. Rings and dicentrics predominated and were found in percentages ranging up to 8% dicentrics and 5% rings. These were significantly elevated up to 6 months after irradiation. Chromosome and chromatid deletions and endoreduplicated cells were also increased significantly and persisted for 6 months. No aberrations were found in cell cultures prepared prior to irradiation. (H.L.W.)

39382 THE EFFECTS OF X RAYS ON THE CHROMOSOMES OF LOCUST EMBRYOS. III. THE CHROMATID ABERRATION TYPES. Fox, D. P. (Marischall Coll., Aberdeen, Scotland). Chromosoma, 20: 386-412(1967).

Embryo mitoses of the desert locust Schistocerca gregaria were used for studying the production of chromatid aberrations by x ray rays. The G_2 and part of the S stages of interphase were examined. A detailed account is given of the chromatid aberration types. In general, they were similar to those previously found in Vicia faba but differed quantitatively and qualitatively in that a large proportion of the aberrations involved both chromatids of a chromosome at apparently homologous loci. This applied to gaps, true discontinuities, intrachanges, and interchanges. Gaps frequently accompanied exchanges, being either present at the presumed point of exchange or in the sister chromatid at the homologous locus to the point of exchange. The intrachanges described, which were not previously reported, were characterized by insertion of paired sister chromatid regions, similar to paired minutes, in the chromatid and sometimes incomplete in various positions. These were named insertion intrachanges. To account for the aberration types observed, a scheme is presented based upon the exchange hypothesis of Revell. The Schistocerca system differed from Vicia faba in the occurrence of large numbers of isolocus gaps. To account for this phenomenon a spreading effect was postulated such that the interaction of an x ray track with one chromatid leads in some way to the involvement of the second chromatid in the production of an isolocus primary lesion. Gap flexion and association, the association of gaps with exchanges, incomplete exchanges and true discontinuities are all seen as representing failure of some stage of the exchange process. (BBB)

39383 THE VARYING X RADIATION SENSITIVITY OF THE GENOMES OF OENOTHERA BERTERIANA. Krautblatter, H.; Arnold, C. G. (Univ. of Erlangen, Ger.). Radiat. Bot., 7: 283-7(1967). (In German).

The genome complexes of the complex heterozygous species Oenothera berteriana are designated as B and l. The egg-cells of this plant were irradiated with x rays of various doses. Subsequently, the irradiated plants were crossed with hybrids of Oenothera that transmit the genomes B and l respectively only by the male sex. Since there appear to be no plants with the homozygous combinations B.B and l.l, the F_1-generation will contain only plants of the combination B.l. The B.l-offspring from the hybridization B.l × l contain an irradiated B genome and a non-treated l genome; the offspring from B.l × B, however, contain a non-treated B genome and an irradiated l genome. Thus a comparison was possible between the various degrees of radiosensitivity of the two genomes. It was possible to demonstrate that, after irradiating the l-genome, seedling percentage and rate of survival decreased more than after irradiating the B genome. In addition, there was a greater increase in F_1-aberrants after irradiating the l-genome than after irradiation of the B genome. This fact suggests clearly that radiosensitivity is higher in the l-genome. The F_1-aberrants were subjected to genetic as well as cytological studies. By these studies it was possible to prove that irradiation caused more chromosome aberrations in the l-genome than in the B-genome. There is no doubt that increased radiosensitivity of the l-genome is due to this increased rate of aberration; the increased radiosensitivity may be deduced from seedling percentage, rate of survival, and number of F_1-aberrants. (auth) (UK)

39384 MONOSOMICS IN MAIZE INDUCED BY X IRRADIATION OF THE POLLEN. Baker, R. L.; Morgan, D. T. Jr. (Maryland Agricultural Experiment Station, College Park). Cytologia (Tokyo), 31: 172-5(June 1966).

An account is given of the induction of monosomics in maize following x irradiation of the pollen with 500- and 1000-R doses. Five plants having monosomic microsporocytes were isolated from the X_1 generation following crosses of $zb_4P^{wr}br_1$ by irradiated pollen carrying $Zb_4P^{wr}Br_1$. Three plants were hemizygous for all three recessive markers in chromosome one. Since the marked region contains the centromere, and all dominant marker genes from the pollen parent were deficient, it was concluded that chromosome one was missing. Root tips of two of the three plants were in division and were monosomic. Two other plants with 19 chromosomes in the pollen mother cells were also found. One plant had 19 chromosomes in the root tips; mitosis was not obtained in the other. These two plants were not hemizygous for all three recessives in chromosome one, suggesting that a different chromosome was lost. (BBB)

39385 A SEARCH FOR GENETIC EFFECTS OF HIGH NATURAL RADIOACTIVITY IN SOUTH INDIA. Grueneberg, H.; Bains, G. S.; Berry, R. J.; Riles, Linda; Smith, C. A. B.; Weiss, R. A. Med. Res. Counc., Spec. Rep. Ser., No. 307, 59p(1966).

The coastal area between Neendakara and Kayankulam, in Kerala, South India, has high natural radioactivity owing to monazite sand that contains Th. The mean γ radiation level on the coastal strip is about 7½ times that of inland areas. A search for genetic damage in rats inhabiting this area was made by examining skeletons and teeth of 438 rats from 8 localities on the strip and 458 rats from 8 control localities inland. Data were also collected on fertility and embryonic mortality of the rats. Six dental and 15 skeletal measurements were made. The degree of genetic differentiation was about the same in both groups of populations; however, there was no systematic difference between the irradiated population group and the control group. The same situation was encountered for the nonmetrical skeletal characters. Similarly, though individual populations differed from each other, there was no systematic difference in fertility or embryonic mortality between irradiated and control populations. Results indicated that γ rays, at the extremely low dose rate to which the Kerala rats were exposed ($^1/_{300}$ of the lowest dose rate for which a genetic effect has been demonstrated) did not induce mutations. (BBB)

39386 GENETIC STUDIES IN THE COSMOS. Parfenov, G. P. Kosm. Issled., 5: 140-55(Jan.-Feb. 1967). (In Russian).

A review is presented of Soviet and other foreign literature on genetic studies in the environment encountered in space from 1930 to 1965. The results obtained in experiments with balloons, rockets, and satellites with microorganisms, plants, and animals exposed to radiations in space in vivo and in vitro are reported separately. A brief analysis is given of the experimental data. (150 references.) (tr-auth)

39387 INDUCED POLYGENIC MUTATIONS IN HEXAPLOID WHEATS. Goud, J. V. (Indian Agricultural Research Inst., New Delhi). Radiat. Bot., 7: 321-31(1967).

Six varieties of bread wheat (Triticum aestivum) were treated with physical and chemical mutagens to evaluate their efficiencies for producing polygenic mutations and to assess the value of such mutations for improving yield and tillering. The M_2 variance was increased by most of the treatments, with a skewness in the range towards the positive direction for tiller number and yield in NP876 and NP862 with gamma and fast neutron treatments. In the other treatments the mean was the same as in the control, or sometimes shifted in the negative direction. Ethyl methane-sulfonate treatments gave a negatively skewed distribution for both the characters in all six varieties. The gamma 20 kR and fast neutron 10 and 12 hr. treatments gave a significant increase for tiller number, and gamma 30 kR and fast neutron 10 hr treatment gave highly significant increases for yield in a low tillering variety (NP876). Thus, polygenic mutations seem to follow a trend opposite in direction of that of the previous selection history of a variety. In the M_3 generation, selections have been effective for high-tillering lines with greater genetic variance in treated progenies compared to control progenies. Some of the low tillering and medium tillering selections excel the high tillering selections in some families, indicating a lack of expression of genetic variance. (auth) (UK)

39388 MUTAGENIC ACTION OF UV ON THE OOGONIA OF DROSOPHILA. II. EFFECTS OF DOUBLE-ILLUMINATION AND OF DOSE-FRACTIONATION ON MUTATION RATE. Proust, Jacqueline; Flamand, Anne (Univ., Paris, Orsay, France). Mutat. Res., 4: 491-501(July-Aug. 1967). (In French).

Recessive lethal mutations are induced by uv light in Drosophila oogonia by irradiating in vitro ovary primordia that afterwards are implanted into host larvae. A constant dose of 2000 ergs/mm^2 was used with 3 methods of irradiation. The whole dose given was at once in one direction (control); the dose was given in 2 halves separated by a 2-hr interval without change of direction; and half of the dose was given in one direction and the other half in the opposite direction. As compared with the control, the second method leads to a decrease both in the mutation frequency and in the absolute size of the cluster of identical lethals. The third method leads to an increase in the mutation frequency and a decrease in both the probability of success of the implantation and the size of the total progeny produced by the implanted ovary. Differences between effects after treatment according to the third method and the control favor the assumption that the different cell layers of the primordium do not receive the same amount of radiation. At high doses the recovered eggs tend to arise only from the less damaged oogonia. This mechanism can account for part of the decrease in the frequency of recovered mutations which is observed at high doses. Differences between the effects after treatment according to the second method and the control point to an additional mechanism. The correlation between the size of the clusters and the mutation frequency that was obtained is quite general. It was also observed when high and low doses were compared. The reduction of cluster size is probably the outcome of a delay imposed by the irradiation on the resumption of DNA synthesis. With this delay, the probability that premutational lesions undergo dark repair is increased. (auth)

Health Physics and Safety

Refer also to abstracts 38871, 39051–39053, 39055, 39056, 39082, 39095, 39185, 39270. 39322, 39326, 39347, 39362, 39366, 39373, and 40438.

39389 (ABS-THH-1032) ZWEI RECHENPROGRAMME ZUR AUSWERTUNG DER ERGEBNISSE VON ZUWACHSFAKTORMESSUNGEN. (Two Computer Programs for Evaluation of Results of Growth Factor Measurements). Vogt, H. G. (Technische Hochschule, Hanover (West Germany). Arbeitsgruppe fuer Bautechnischen Strahlenschutz). July 1966. 62p. (In German). DTIE.

Two computer programs for the automatic evaluation of the results of growth factor measurements are presented. The method by which the dose growth factors for monoenergetic gamma radiation can be determined from the effective dose growth factor for spectrally distributed γ radiation was described. A simplification and expansion of the computer program given earlier (ABS-THH-1012) for the determination of dose values from pulse height spectra was formulated. The program language is Algol. (tr-auth)

39390 (AD-631026) NUCLEAR BLAST EFFECTS ON A METROPOLITAN ECONOMY. Truppner, William C. (Institute for Defense Analyses, Arlington, Va. Economic and Political Studies Div.). Sept. 1965. Contract OCD-OS-63-134. 117p. CFSTI.

The study summarizes the work done to develop a method for measuring the nuclear blast effects on the economic resources of a single city. The method developed was applied to data describing the Houston, Texas, Standard Metropolitan Statistical Area. The results were expressed in terms of weapon effects on economic output, property values, and population characteristics including the experienced labor force. The study indicates the methods used to obtain the input data required to analyze weapon effects on the economy of a large metropolitan area. The study also includes a description of the problems encountered in developing the data and the steps taken to overcome such difficulties. These data were distributed to single cells of a 65 × 65 one-kilometer square matrix which was used to measure overpressure effects on economic resources for eight weapons of yields ranging from 0.1 megaton to 100 megatons. Weapon effects on economic resources were related to effects on the population of Houston for the same simulated attack conditions. (TAB)

39391 (AECL-2656) ONE-DAY INTRODUCTION TO RADIATION PROTECTION PRINCIPLES. Fenn, J. H.; Bush, W. R.; Watson, L. C. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Apr. 1967. 43p. Dep. CFSTI. CAN $1.50.

The fundamentals of radiation hazards and their control are outlined. This one-day course is presented to all classes of radiation workers at CRNL, usually during their first month of employment. The purposes of the course are to outline the fundamentals of radiation hazards control, to describe methods that enable employees to work safely with radiation, and to acquaint employees with the CRNL radiation and industrial safety organization. (auth)

39392 (AHSB(RP)R-76) THE STANDARDISATION OF PRESSURISED SUITS. (United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch). June 1967. 18p. Dep. CFSTI. UK 5s. 6d.

Standards are specified for light-duty pressurized suits and blouses, personnel air hoses, and their connecting fittings. The work leading to the specification of such Standards is described. In addition to the articles mentioned, standards are also specified for air-line hoods and oversuits. Although it was not found possible to draft a standard for personnel air hose couplings, a specification of preferred design characteristics for such devices was prepared. Prototypes of the standard clothing have been subjected to trials and the standard specifications take account of the few changes of a minor nature shown to be necessary by these trials. (auth) (UK)

39393 (AHSB(RP)R-78) THE APPLICATION AND INTERPRETATION OF ICRP RECOMMENDATIONS IN THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY (JUNE 1967). Dunster, H. J. (United Kingdom Atomic Energy Authority, Harwell

(England). Authority Health and Safety Branch). June 1967. 20p. Dep. CFSTI. UK 3s. 6d.

The current recommendations of the International Commission on Radiological Protection have been endorsed for use in the United Kingdom by the Medical Research Council, and adopted by the United Kingdom Atomic Energy Authority. This report summarizes the principal recommendations and gives guidance on how they should be interpreted. (auth) (UK)

39394 (BMwF-FBK-67-57) UNTERSUCHUNGEN ZUR DEKONTAMINIERUNG RADIOAKTIV VERUNREINIGTEN ZISTERNENWASSERS. (Investigations on the Decontamination of Water From Cisterns Contaminated by Fallout). Aurand, K.; Wolter, R. (Bundesgesundheitsamt, Berlin (West Germany). Institut fuer Wasser-, Boden- und Lufthygiene). June 1967. 100p. (In German). Dep.

Investigations were performed on decontamination of drinking water, especially water from cisterns. To describe the efficiency of devices and processes the decontamination factor (DF) is used, i.e., the ratio of the specific activities of raw and purified water. By ion exchange a DF up to 600 can be obtained. The DF depends on the purification of the water before ion exchange treatment. Distillation of the water results in DF as high as 10,000. A DF higher than 100 was obtained by a precipitation method, which is still under development. The characteristics of the different decontamination processes are discussed. (auth)

39395 (BNWL-SA-1255) CURRENT RESEARCH ON AEROSOLS AT PACIFIC NORTHWEST LABORATORY. Postma, A. K.; Schwendiman, L. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 10, 1967. Contract AT(45-1)-1830. 11p. (CONF-670609-1). Dep. CFSTI.

From 60th Annual Meeting of the Air Pollution Control Association, Cleveland, Ohio.

Abstracts describing topics of current research directly related to aerosols are presented. Topics include air cleaning, air sampling, particle inhalation, toxicity, and other areas related to control of airborne contaminants in the environment. (B.H.S.)

39396 (BNWL-SA-1327) FALLOUT RADIONUCLIDES IN NORTHERN ALASKAN ECOSYSTEMS. Hanson, W. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 10, 1967. Contract AT(45-1)-1830. 28p. (CONF-670715-1). Dep. CFSTI.

From Symposium on Circumpolar Health Related Problems, College, Alaska.

Studies of radioactive fallout in Alaskan arctic ecocystems were conducted during the period 1959 to 1967 to define routes, rates, and amounts of several radionuclides in a region where wildlife resources are important to human welfare. Emphasis was placed on seasonal measurements of ^{90}Sr and ^{137}Cs in all trophic levels of the lichen-herbivore-carnivore food web at Anaktuvuk Pass during the years 1962 to 1967. Cesium-137 concentrations increased by a factor of two at each successive trophic level of the lichen-caribou (reindeer)-man (wolf) food chain. This resulted from the unusual capacity of lichens to absorb and retain fallout materials, especially ^{137}Cs; the utilization of lichens as a basic winter food by caribou and reindeer; and the dependence upon caribou and reindeer for food by northern peoples and wolves. Strontium 90 was less important than ^{137}Cs because it was more mobile in lichens and tended to be blocked from appreciable transfer to carnivores by accumulation in bone. Regional and local differences in ^{137}Cs concentrations were noted among plant and animal species and among ethnic groups of natives. A definite seasonal cycle of ^{137}Cs was found in the biota which illustrated their close relationship to the environment and the simple structure of arctic ecosystems. Cesium-137 concentrations in caribou flesh and Eskimos at Anaktuvuk Pass attained maximum values during spring and summer months, respectively. Unusually high values during 1964 and 1966 were ascribed to caribou migrations from distant winter ranges with greater ^{137}Cs in lichens than measured at Anaktuvuk Pass, and the subsequent use of these animals by the Eskimos. Radiation exposure of Anaktuvuk Pass Eskimos from ^{137}Cs body burdens during each year of the period 1962 to 1966 varied from 59 to 144 millirem, which is of the same order as natural background radiation. Except for brief periods, ^{90}Sr ingestion rates via caribou meat was within Range I of Federal Radiation Council Radiation Protection Guides. It is concluded that appreciable amounts of fallout radionuclides, especially ^{137}Cs, will remain in Alaskan biota for several years. The radiation exposure is not now, nor expected to be, hazardous to animals (including man). (auth)

39397 (KAPL-P-3366) EXPERIENCES WITH LATEX-TYPE MATERIALS AS DECONTAMINATING AGENTS. Sugalski, A.; Jagielski, E. J. (Knolls Atomic Power Lab., Schenectady, N. Y.). July 15, 1967. Contract W-31-109-eng-52. 7p. (CONF-671102-12). Dep. CFSTI.

For Presentation at 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

A strippable latex material was found to be very effective for removing loose contamination from surfaces exposed during hot cell operations. The latex material is painted on the surfaces to be decontaminated, allowed to dry and then stripped off in large sheets. The removed material can be discarded as solid waste and does not require further treatment. The surfaces decontaminated included wood, brass, Durel, hard rubber, concrete (painted and unpainted), lead, glass, and plexiglass. It is shown that this latex material will confine contamination. Contamination did not adhere to rubber gloves while working with the material. (M.C.G.)

39398 (LA-DC-8608) PERSONAL AIR SAMPLING AND MULTIPLE STAGE SAMPLING; INTERPRETATION OF RESULTS FROM PERSONAL AND STATIC AIR SAMPLERS. Schulte, Harry F. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 14p. (CONF-670621-3). Dep. CFSTI.

From Symposium on Radiation Dose Measurements, Their Purpose, Interpretation and Required Accuracy in Radiological Protection, Stockholm, Sweden.

Radioactive material in the air must be measured in order to limit the radiation dose to personnel from internally deposited radioisotopes. From these measurements, efficiency of the control equipment can be determined, and the rate of internal deposition can be estimated. Fixed samplers are used at various plant locations, and personal samplers are worn by workers. Difficulty was found in correlating the two types of samplers in that wide variations exist in the ratios of measurements taken on the fixed sampler to measurements taken on the personal sampler. A new two-stage sampler was used in conjunction with the fixed samplers in plutonium metal fabrication, plutonium chemistry, and uranium processing areas. Particle-size measurements from the two-stage samplers indicated a lower hazard than had been shown by the fixed samplers. The principal value of all these samplers is in evaluation of dust control effectiveness. The personal samplers permit the detection of local high concentrations. The two-stage sampler gives information on particle size that may be used to identify a dust source. (W.E.B.)

39399 (NP-16524) O PODVIZHNOSTI I FORMAKH NAKHOZHDENIYA STRONTSIYA-90, STABIL'NOGO STRONTSIYA I KAL'TSIYA V DERNOVO-PODZOLISTOI I CHERNOZEMNOI POCHVAKH. (Migration and Chemical Forms of ^{90}Sr, Stable Strontium, and Calcium in Sod-Podzolic and Black Earth Soils). Pavlotskaya, F. I.; Zatsepina, L. N.; Tyuryukanova, E. B.; Baranov, V. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 21p. (In Russian). Dep.

In the arable level of sod-podzolic soils, the mobility of ^{90}Sr, stable Sr, and Ca was almost the same and was about 90%; in typical black earth the mobility of radioactive and stable Sr was of the order of 65%, and Ca was 85% (mobility was defined as the ratio of the sum of the concentration in water solution and total concentration to the concentration in acid solution, expressed in percent). In virgin soil the same regularities in the mobility were observed, but with much lower values. The differences observed in the size of the mobility of the elements studied in sod-podzolic clay soil in comparison with black earth was explained primarily by the possibilities of its occurrence in a water-soluble form. Strontium-90 occurred in a water-soluble form to a greater degree than stable Sr and Ca. Except for the physical-chemical properties of soils, the most significant effect on the form of occurrence, the mobility, and character of the distribution in soil profiles of ^{90}Sr, stable Sr, and Ca was the source of its input, especially the genetic composition for virgin soil. (tr-auth)

39400 (NP-16865) ASSAY OF ^{90}Sr IN HUMAN BONE IN THE UNITED KINGDOM. Results for 1966. Part I. Monitoring Report No. 14. (Medical Research Council, London (England)). 1967. 15p. Dep. CFSTI. UK 2s. 0d.

The content of ^{90}Sr in bone samples for January to June 1965 and 1966 as determined in Glasgow and UKAEA surveys are presented. A difference was found in the ^{90}Sr concentrations of femoral and vertebral bones in adults; the concentration was two to three times more in vertebral bone than in femoral bone. The results for infants and young children indicated a trend to lower values than in preceding years. (B.H.S.)

39401 (NP-16887) RADIOACTIVE CONTAMINATION OF AIRCRAFT. Code of Practice for the Protection of Persons Ex-

posed to Ionising Radiations Arising from the Radioactive Contamination of Aircraft (Airframes, Engines, and Components). (Ministry of Aviation, London (England)). 1966. 44p. UK 4s. 6d.

The British code of practice for the protection of persons exposed to radiation hazards from the radioactive contamination of the exterior surfaces of aircraft is presented. The contamination arises from aircraft flying through the stratosphere which has retained radioactive dust from nuclear explosions. The legal responsibilities of aircraft and radiation monitoring personnel are given. Monitoring equipment and procedures are specified. Procedures for the decontamination of aircraft surfaces, and the handling of radioactive wastes are detailed. (L.C.L.)

39402 (ORNL-4032) TISSUE CURRENT-TO-DOSE CONVERSION FACTORS FOR NEUTRONS WITH ENERGIES FROM 0.5 TO 60 MeV. Irving, D. C.; Alsmiller, R. G. Jr.; Moran, H. S. (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 87p. Dep. CFSTI.

To assist in the evaluation of the hazard associated with exposure to high-energy neutrons, a Monte Carlo computer program was used to calculate the energy deposition as a function of depth in a 30-cm-thick infinite slab of tissue resulting from neutrons incident on the slab at energies up to 60 MeV. The program treated nonelastic and elastic interactions, including evaporation processes and nuclear recoils. Cases of both normal and isotropic incidence were calculated for neutrons of 0.5, 2, 10, 18, 30, and 60 MeV. From these data, current-to-dose conversion factors were extracted for the average whole-body dose, the dose at a 5-cm depth, and the maximum dose. A set of quality factors (QF's) was adopted for transforming rad dose to rem dose, but detailed energy deposition data are also presented so that any preferred set of QF's can be used to obtain estimates of the rem dose. (auth)

39403 (ORNL-TM-1921) CALIBRATION OF $^{90}Sr + ^{90}Y$ PLAQUES FOR IRRADIATING INSECTS. Roti Roti, Joseph Lee; Kaye, Stephen V. (Oak Ridge National Lab., Tenn.). July 18, 1967. Contract W-7405-eng-26. 22p. Dep. CFSTI.

Calibration dose-rate measurements were made above two 34 cm diameter plane-disk sources containing approximately 75 mCi and 750 mCi of $^{90}Sr + ^{90}Y$, respectively. The contact dose rate in the center of the 75 mCi source was 656 rads/hr and the measured dose rate at contact in the center of the 750 mCi source was 4950 rads/hr. The data presented are intended to be useful in the planning of experiments for investigation of the effects of radiation on insects. (auth)

39404 (SC-M-67-431) APPLICATION OF TRICHLOROACETIC ACID LEVEL IN URINE AS A MEASURE OF TRICHLOROETHYLENE VAPOR EXPOSURE. Parker, D. R. (Sandia Corp., Albuquerque, N. Mex.). July 1967. 9p. Dep. CFSTI.

Trichloroacetic acid is a natural metabolite of trichloroethylene that is readily recoverable from urine specimens. The amount of trichloroacetic acid excreted in the urine is generally a function of the trichloroethylene vapor exposure. Although the day-to-day excretion levels fluctuate significantly, they can be used as an aid in evaluating an individual's exposure to trichloroethylene vapor when a series of samples are analyzed. (auth)

39405 (SC-RR-67-461) USE OF RESPIRATORS AND METHODS OF DETERMINING FACE FIT. Juskiewicz, A.; Skillern, C. P. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. 11p. Dep. CFSTI.

The methods that are used for determining face fit for respiratory protective devices at Sandia Laboratory are described. Individuals are tested, after their threshold for amyl acetate has been determined, in a room containing a known concentration of amyl acetate. The penetration between the mask and the face is determined by using this information. The criteria for mask issue are given with cleaning and maintenance procedures. (auth)

39406 (SC-RR-67-563) LASER EYE HAZARD EVALUATIONS. Burnett, W. D. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. 18p. Dep. CFSTI.

Equations for calculating direct laser intensity levels on the human retina are described and related to so-called safe retinal intensity levels extracted from a review of current literature. (auth)

39407 (TID-23942) PREDICTING THE UNPREDICTABLE. PROBLEMS IN ESTIMATING THE BIOLOGICAL AND ENVIRONMENTAL CONSEQUENCES OF NUCLEAR WAR-II. Hollister, Hal; Threlkeld, James D. (Division of Biology and Medicine (AEC), Washington, D. C. Technical Analysis Branch). Apr. 1967. 23p. (TAB-R-8). Dep. CFSTI.

Problems encountered in estimating the biological and environmental consequences of intercontinental thermonuclear warfare are reviewed. It is pointed out that it is essential for the people of the United States to acquire some understanding of what an all-out nuclear attack may mean in order to decide the extent of civil defense preparations necessary for minimizing damage and improving prospects for recovery and to determine whether or not such preparations can be made without undermining the values of a free society. Contrasting points of view are discussed on whether or not national survival and recovery would be possible, even though a significant number of persons are protected from the initial blast, fire, and radiation. The economic, political, social, and psychological impacts of nuclear warfare, as well as the effects on disruption of the biosphere are considered. (C.H.)

39408 (Y-KB-77) HEALTH PHYSICS APPLICATION OF IN VIVO GAMMA SPECTROMETRY IN A URANIUM PROCESSING PLANT. Scott, L. M.; West, C. M. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Aug. 17, 1967. Contract W-7405-eng-26. 15p. (CONF-670521-11). Dep. CFSTI.

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash.

In vivo gamma spectrometry has been used routinely for the past six and one-half years in the health physics monitoring of uranium processing workers. The major problems associated with the technique are: effects of surface contamination, relative insensitivity of the methods, and the difficulty of predicting the base spectrum in the uranium region. The solutions to these problems at Y-12 have been: use of the back detector data when contamination is indicated, (2) increase in the number of detectors, and derivation of a prediction equation and a counting of a control population to assure continued reliability of the equation. Experience has shown that urinalysis will not point out all exposure cases and that generally once a person has been removed from uranium exposure, the urine level will return to acceptable levels long before in vivo measurements do. Consequently, it has been concluded that in vivo spectrometry is superior to urinalysis as a monitor for insoluble uranium. However, for soluble uranium and areas of low exposure potential, urinalysis is of real value. (auth)

39409 (LA-tr-67-66) AIR MONITORING IN URANIUM MINES. Pradel, Jacques. Translated by Benjamin Thayne from Paper Presented at Symposium on Radiation Dose Measurements, Their Purpose, Interpretation and Required Accuracy in Radiological Protection, Stockholm, Sweden, June 12-16, 1967. 27p. (CONF-670621-4). Dep. CFSTI. JCL $2.60 fs, $1.01 mf.

Radioactive contamination of air in uranium mines is characterized by the presence of Rn and its short-lived daughters and by radioactive dust formed through mechanical dispersion of the ore particles. Protection of the miners is achieved only with very frequent monitoring and rigorous observance of industrial hygiene regulations. In French mines the monitoring of personnel consists in keeping a record of the radiation dose, measured in terms of both Rn and radioactive dust concentrations, based on the time spent at the work site. This necessitates a large number of measurements, the statistical analysis of which permits determination of the doses inhaled. A simplified monitoring technique is described that consists of sampling and measurement of the Rn in a $^{125}Cm^3$ scintillation chamber, and use of a scintillation counter to measure the activity of dust samples collected on filters by means of a compressed air ejector. The technique allows the calculation of the cumulative radiation dose in the lungs from external radiation, Rn, and dusts. A formula is included for use in calculating the quarterly cumulative dose to each employee. The annual cumulative dose may be calculated from quarterly results. Recommendations of the International Commission on Radiological Protection for maximum permissible concentrations of Rn in air are reviewed, and applications for the maximum permissible concentration of radioactivity in uranium mines are discussed. (C.H.)

39410 SAFETY CONTROLS OF IAEO AND EURATOM. Berger, R. Atomwirtschaft, 12: 172-4(Apr. 1967). (In German).

The safety control systems of the IAEO and Euratom are compared with respect to the extent of control, type of control, inspections, sanctions, and protection against control infringements. (tr-auth)

39411 EVALUATION OF RADIATION EXPOSURE FROM INTERNAL DEPOSITION OF THREE BONE-SEEKING RADIONUCLIDES. Butler, G. C.; Veld, A. (National Research Council, Ottawa, Can.). Health Phys., 13: 916-18(Aug. 1967).

With regard to the decline of the body content of a radioactive substance absorbed into the blood or lymph as a result of a single isolated contamination event, in the case of a few nuclides the decline with time, from a few days to a few decades, may be described by a power function of form At^{-n}, where A is the extrapolated fractional retention at 1 day, t is the number of days, and n lies between 0 and 1. Some bone-seeking radionuclides (^{45}Ca, ^{47}Ca, ^{85}Sr, ^{89}Sr, ^{90}Sr, ^{140}Ba) showing this type of retention, and having radioactive lives sufficiently short that decay must be considered, are listed. In order to estimate the number of micro-

curie-days of exposure it is necessary to integrate the retention equation over some finite period of time. If the radioactive decay is appreciable during this period it must be taken into account, by integrating $At^{-n} \times \exp(-\lambda t)$, where λ is the radioactive decay constant. Such expressions are difficult to integrate. A computer program was designed to evaluate the integrals for values encountered in the practice of radiation protection; the values obtained are tabulated. (UK)

39412 RECONSIDERATION OF THE ^{131}I CONTRIBUTION FROM FRUITS AND VEGETABLES. Thompson, J. C. Jr. (Cornell Univ., Ithaca, N. Y.). Health Phys., 13: 883-7(Aug. 1968).

Fruits and vegetables could have been responsible for 13 to 54 per cent of the total ^{131}I intake during 1962, among those segments of the population consuming large quantities of farm fresh foods. It is suggested that attention be directed toward fresh fruits and vegetables as a significant contribution of ^{131}I under specific circumstances. Although measures to combat intake from this source are relatively simple (convert to processed or canned food products) there should be some definite basis for decisions of this type. (auth) (UK)

39413 ^{55}Fe IN MAN AND THE BIOSPHERE. Palmer, H. E.; Beasley, T. M. (Battelle Memorial Inst., Richland, Wash.). Health Phys., 13: 889-95(Aug. 1967). (BNWL-SA-797).

Since the 1961 to 62 nuclear tests ^{55}Fe has increased from a minor fraction of fallout to the most abundant of all fallout isotopes. Iron-55 is easily measurable in almost all living organisms of the biosphere. Although it produces only a small radiation dose, the study of its transfer and concentration in various organisms is of interest because iron is an essential element to most of these organisms. Data are presented on the levels of ^{55}Fe in man at many places on the earth, in foods, in the ocean environment, and attempts are made to correlate some of these levels. The average levels of ^{55}Fe range from 5 nCi in people in South Africa to 1100 nCi in some of the Alaskan Eskimos. Average levels in women are significantly higher than in men. The highest levels in humans are associated with a high consumption of ocean fish. (auth) (UK)

39414 FALLOUT ^{137}Cs: DIRECT AERIAL TRANSFER AS AN IMPORTANT SOURCE OF FOLIAR DEPOSITION. Wilson, D. W.; Ward, G. M.; Johnson, J. E. (Colorado State Univ., Fort Collins). Contract (11-1)-1171. Radiat. Bot., 7: 312-19(1967). (COO-1171-48).

A four acre stand of alfalfa was systematically sampled and analyzed for ^{137}Cs during the 1965 growing season. In addition, the deposition of fallout ^{137}Cs in rainfall and surface air concentrations was measured. A small section of the field was covered to exclude fallout deposition by rainfall. The ^{137}Cs in alfalfa in the open field increased during rainless periods, while during the rainy periods the alfalfa levels often decreased. While the levels in the open field were higher than under the shelter, the differences were not great enough to indicate that deposition from rainfall was a primary factor in the contamination of alfalfa in the normal environment. Overall deposition velocities for transfer of surface air ^{137}Cs to vegetation were calculated by neglecting the possibility of contamination from rain, but considering the exponential decay-rate of deposited ^{137}Cs. Overall deposition velocities were calculated for transfer of surface air ^{137}Cs to vegetation without regard for deposition from rain in the open field and compared with the deposition velocities calculated for the covered alfalfa. For a first cutting of alfalfa, which grew from late May through July, the deposition velocities were 920 and 690 m/day, for unsheltered and sheltered alfalfa, respectively. The equivalent deposition velocities for a second harvest were 260 and 310 m/day for unsheltered and sheltered alfalfa. (auth) (UK)

39415 EVALUATION OF LUNG BURDEN FOLLOWING ACUTE INHALATION EXPOSURE TO HIGHLY INSOLUBLE PuO_2. Mann, J. R.; Kirchner, R. A. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. Health Phys., 13: 877-82 (Aug. 1967).

On 15 October 1965 a fire in a plutonium fabrication plant resulted in a large-scale spread of plutonium oxide. The Rocky Flats body counter was used to measure the plutonium in the lungs of all employees working in the area. Of approximately 400 employees counted, 25 were found to have enough plutonium in their lungs to deliver a dose of 15 rem/yr or greater. Data from each employee were obtained with two scintillation detectors in contact with the subject's chest. The 60-keV photon peak of ^{241}Am was used in the measurements. The ^{241}Am content of the plutonium released in the fire was determined and the plutonium quantity was then determined from calibrations done on a chest phantom with similar $^{241}Am/^{239}Pu$ ratios. The plutonium consisted of high-fired PuO_2. Measurements of particle size in air samples collected after the fire indicated a 0.32-μ mass median diameter (MMD) with a geometric deviation (σ_g) of 1.83. Lung data so far show very slow clearance. This confirms the high degree of insolubility and the small particle size. On the average, 30 per cent of material initially deposited was cleared in 2 to 3 months. The remaining material is clearing very slowly, with little or no measurable absorption into the bloodstream. (auth) (UK)

39416 DOSIMETRIC SUBSTANTIATION OF GAMMA-THERAPY WITH A LATTICE. Novikova, L. V.; Pavlova, T. G.; Stenin, D. C.; Uskov, I. A. Med. Radiol., 12: 14-18(Jan. 1967). (In Russian).

By means of photometric and chemical modes of dosimetry the distribution of ionizing radiation in a tissue-equivalent medium during gamma-irradiation with a 40 per cent lattice and without it was investigated. The investigations showed that the employment of a lead lattice in gamma-therapy made it possible to obtain in the focus of affection under open areas of the lattice a dose three times greater than in irradiation without the latter in similar integral absorbed doses. (auth)

39417 AN ACCELERATED METHOD OF CHOICE AND CALCULATION OF DOSE FIELDS IN DISTANCE GAMMA-THERAPY OF DEEPLY SITUATED TUMORS BY MEANS OF THE MULTI-FIELD TECHNIQUE ON ROTATION GAMMA-EMITTERS. Aliev, B. M.; Misyunas, I. I.; Ratner, T. G. Med. Radiol., 12: 68-71 (Jan. 1967). (In Russian).

The features specific to rotation γ-emitters make it possible to use a simplified method for calculating the dose field. When there is a similar distance between source-focus and dose field at the level of the focus, the administration of a 100% dose to each irradiated field is possible. The forms of the patient's body and distance values between source and skin do not exert any essential influence on the nature of radiation energy distribution in the irradiated medium. Therefore, a series of charts of dose fields for the most common physico-technical conditions of irradiation could be prepared and utilized for the treatment of all patients. On the average, 1.0 to 1.5 hours were required for the preparation of dosimetric characteristics (dose field, focal dose, skin dose, integral absorbed dose, dose in critical organs, and the efficacy of the method) when this method was used. (auth)

39418 FALLOUT ^{137}Cs AND POTASSIUM IN NEWBORN INFANTS. Wilson, A. R.; Spiers, F. W. (Univ. of Leeds, Eng.). Nature (London), 215: 470-4(July 29, 1967).

New techniques of low background counting have made possible the measurement of intake and retention of natural potassium and cesium-137 in infants. The biological half-lives of both potassium and cesium-137 are from 5 to 10 times lower than the corresponding values in adults. (auth) (UK)

39419 ACTIVE γ FISSION PRODUCTS IDENTIFIED IN SEA PLANKTON. Iorgulescu, A.; Oncescu, M.; Serbanescu, O.; Porumb, R. Stud. Cercet. Biol., Ser. Zool., 17: 571-7(1965). (In Romanian).

Zooplankton specimens collected from the upper layer of the Black Sea near the Romanian shore were studied. Composition ratio of each species was determined in percentages for every sample and subsequently β radioactivity was measured in a small amount of ashes by means of a ^{90}Sr standard window meter, with an activity of 100 pCi. The ashes resulted from calcinating the zooplankton at gas flame during 4 to 5 hours. A close correlation between β radioactivity found in the investigated specimens, and the atmospheric fallout was evinced. The spectrometric analysis disclosed the presence of the artificial radionuclids ^{125}Sb, ^{125}Te, ^{106}Ru, ^{144}Ce, and ^{137}Cs, which are all fission products. Cesium-137 was shown to be highly radiotoxic. Since such fission products of high biological toxicity were identified in the sea plankton, further researches on other sea hydrobiontic groups are required. (TSS)

39420 USA STANDARD SAFETY LEVEL OF ELECTROMAGNETIC RADIATION WITH RESPECT TO PERSONNEL. IEEE (Inst. Elec. Electron. Eng.) Trans. Bio-Med. Eng., BME-14: 152 (Apr. 1967).

Recommendations are made to prevent possible harmful effects resulting from exposure to electromagnetic radiation in the frequency range from 10 MHz to 100 GHz. They apply to all radiations originating from radio stations, radar equipment, and other possible sources of electromagnetic radiation such as used for communication, radionavigation, and industrial and scientific purposes. For normal environmental conditions and for incident electromagnetic energy of frequencies on this range, the radiation protection guide maximum exposure is 10 mW/cm^2, as averaged over any possible 0.1-hr period. This guide applies whether the radiation is continuous or intermittent. Exposure to electromagnetic radiation in this frequency range is but one of several sources of heat input into the body. Body temperature depends in part on sources of heat input such as electromagnetic radiation, physical labor, and high ambient temperature, and on heat

dissipation capability as affected by clothing and humidity. People suffering from circulatory difficulties and certain other ailments are more vulnerable. The frequency of radiation and its penetration affect the percentage of absorbed radiation. Hence, the power levels established in the radiation protection guide are related in a complicated way to power levels at which damage occurs. The guide values are appropriate for moderate environments. Under conditions of moderate to severe heat stress the guide number given should be appropriatedly reduced. These formulated recommendations pertain to both whole-body irradiation and partial-body irradiation. (BBB)

39421 TRANSFER OF ^{137}Cs FROM DIET TO MAN. Yamagata, Noboru (Inst. of Public Health, Tokyo). Koshu Eiseiin Kenkyu Hokoku, 15: 177-84(Dec. 1966).

A review is presented of the mechanisms of the transfer of fallout ^{137}Cs from diet to man. Radioecological factors which determine the food chain mechanisms were considered and biological aspects on the metabolism of Cs in the human body were reviewed on the basis of recent world-wide data. Sufficient evidence has been found to indicate a different behavior of Cs and K in various biological systems and there appears little to support the use of element pairs in predicting contamination levels especially in the case Cs–K. Measurements in vivo of the ^{137}Cs body burden by use of whole-body counters are given. Measurements of body burdens showed a time lag of about 8 months between the peaks of ^{137}Cs body burden and cessation of nuclear testing. The biological half-time of Cs in man is short, about 3 months, so changes in dietary intake are followed rapidly by the body burden. This fact, in conjunction with the period of time required for the harvest and distribution of foodstuffs, may result in the time lag of 6 to 9 months between the levels of fallout and body-burden maxima. Attention was drawn to the need of further research on other routes than milk for Cs entry into man, which might play a major part on some occasion or in some groups of intake by the world population. (BBB)

39422 BLOOD LEVELS OF FALLOUT ^{137}Cs IN THE NETHERLANDS, OKINAWA, AND MAINLAND JAPAN. Yamagata, Noboru (Inst. of Public Health, Tokyo); Oshiro, Seisho. Koshu Eiseiin Kenkyu Hokoku, 15: 172-6(Dec. 1966).

Citrated human whole blood samples were collected in order to assess the total-body burden of fallout ^{137}Cs in the body. Ten samples were obtained from blood banks in Amsterdam, the Ryukyu Islands, and 3 cities in Japan. The levels of the body burden in the Japanese people were found to be about one-third (50 to 57 pCi ^{137}Cs/g K) those in Amsterdam residents (176 on the average). The levels in Naha were found to be a little lower than in mainland Japan. The latitudinal distribution of radioactive fallout failed to explain completely the differences in the blood levels between people living in different parts of the world. Interpretation of the observed difference between the northern part (up to 43°N in Sapporo) of Japan and the Netherlands was made on the basis of differences in food habits, namely, a larger daily intake of milk and meat by people in the Netherlands than in Japan. Rather high body levels in the Philippines and Thailand, at latitudes 15°N and 14°N respectively, are thought to be caused by unknown radioecologic factors. (BBB)

39423 ENVIRONMENTAL RELATIONS AND THE PUBLIC HEALTH: INFLUENCE OF LOW DOSE LEVELS OF IONIZING RADIATIONS AND OF SOME OTHER MAN-MADE AGENTS. Sonnenblick, B. P. (Rutgers-The State Univ., Newark, N. J. Newark Beth Israel Hospital, N. J.). J. Newark Beth Israel Hosp., 17: No. 2, 83-99(Apr. 1966).

Data are summarized from a number of studies on the effects of low doses of radiation (50 R or less in air) on animals, plants, and microorganisms. The relation of environmental levels of radiation to other factors affecting public health, such as chemical air pollution, the use of chemical pesticides on food crops, and the use of drugs and chemicals on and within persons, are discussed. It is concluded that at the present time there is unbridled tampering with the environment of all living things and that vast ignorance exists as to specific tolerances and effects. The information from all of the environmental sciences indicates the need for a multiple approach in assuring a safe environment for man. (C.H.)

39424 TOTAL BODY AND BLOOD RADIATION DOSES AFTER ^{131}I-THERAPY OF HYPERTHYROIDISM. Takeshita, Akihisa (Tottori Univ., Yonago, Japan). Yonago Igaku Zasshi, 16: 559-65 (Dec. 1965). (In Japanese).

In 20 cases of hyperthyroidism treated by ^{131}I-administration, the radiation doses of the whole-body, blood, gonads, and bone marrow were studied. The whole-body radiation dose is from the β rays and γ rays of ^{131}I distributed in the whole-body and from the γ rays of ^{131}I concentrated in the thyroid gland. The dose attributable to the former was calculated by assuming that the ^{131}I amount, minus the amount in the thyroid gland and the amount excreted into the urine, was distributed uniformly throughout the body. The dose attributable to the latter was calculated, with 40 cm as the mean distance of the whole-body from the thyroid gland. The whole-body doses were then between 0.12 and 0.76 rads/mCi for 20 cases, or 0.40 rads/mCi on the average (expressed in rads per 1 mCi of administered ^{131}I). The blood dose is from the β rays of ^{131}I in the blood and the γ rays of ^{131}I distributed in the whole-body. The dose due to the former was calculated by successive measurements of ^{131}I concentration in blood after ^{131}I-administration. The blood doses obtained by adding the two together were from 0.31 to 2.27 rads/mCi, or 0.84 rads/mCi on the average. The gonad dose is from the β rays of ^{131}I in blood and the γ rays of ^{131}I distributed in the whole-body. One third of the blood dose due to β rays was used as the dose attributable to the former, because the blood content in the gonad was one third of the gonad weight. The dose due to the γ rays of ^{131}I in the thyroid gland was neglected because the amount was small compared with the other two. The gonad doses were between 0.22 and 0.89 rads/mCi, or 0.51 rads/mCi on the average. Eighty percent of the blood dose due to β rays was taken as the bone marrow dose attributable to the β rays of ^{131}I. The bone marrow doses calculated by adding the whole-body dose due to γ rays to this dose were from 0.27 to 1.87 rads/mCi, or 0.70 rads/mCi on the average. (NSA of Japan)

39425 EFFECTS OF THIRD COMMUNIST CHINESE NUCLEAR TEST. REPORT 3. RADIOACTIVE CONTAMINATION OF DRINK WATER, MILK, AND VEGETABLES IN NIIGATA. Kosaka, Takao; Takizawa, Yukio (Niigata Univ., Japan). Niigata Igakkai Zasshi, 80: 650-3(Dec. 1966). (In Japanese).

Investigations were made of the radioactive contamination of drinking water, milk, and vegetables and on the decontamination of contaminated vegetables, as a part of the comprehensive study of the effects of fallout from the third Communist Chinese nuclear test. There were no effects from the test on the radioactivity contained in potable water and in milk. This fact was of some interest, considering that a large amount of fall-out was observed. The number of highly radioactive particles that fell upon vegetables in the vegetable farm was in general small when compared with that in the ground; the maximum being about $\frac{1}{5}$ that of the latter. Both the number detected and their intensity decreased with the passage of time. The contamination of vegetables was found to be mostly removed by a single washing with water. (NSA of Japan)

39426 THE CALCIUM CONTENT OF BULK MILK SAMPLES FROM ALL PARTS OF THE NETHERLANDS. Eisses, J.; de Ruig, W. G. (Government Dairy Station, Leiden). Neth. Milk Dairy J., 20: 243-55(1966). (In Dutch).

The calcium content of bulk milk samples taken from all parts of the Netherlands was determined at biweekly intervals for several years in connection with the control of radioactive contamination of milk. The calcium content of bulk milk from cattle in the Netherlands (mainly Dutch Friesian and M.R.I.J.) ranged from 0.104 to 0.128% and averaged 0.117%. There was a small but significant seasonal variation of about 7% of the average value; these values ran nearly parallel with the seasonal variation of the protein, fat, and sodium contents of the milk. The differences between the calcium content of the milk from different parts of the country were small, although there were fairly large differences in soil composition. The mean value of milk from the whole country was exactly the same as that found for milk from Friesian-Holstein cattle in Canada. For the determination of the calcium content the a modification of the stannate serum method was used. Replacement of the indicator Eriochrome blue black R, used in this method, by glyoxal-bis-(2-hydroxyanil) gave an end-point that was much more readily visible. A rather large correction for the volume of the precipitate proved to be necessary. The results obtained with this modified stannate serum method proved to agree satisfactorily with those of complexometric calcium determinations on the oxalate precipitate in the solution of milk ash. This last method agreed well with standard oxidimetric oxalate procedures. (auth)

39427 RADIATION INTENSITY IN THE USE OF PORTABLE γ-DEFECTOSCOPES WITH ^{137}Cs AND ^{75}Se COMPOUNDS. Korenkov, I. P. (Moscow Sanitation Epidemiological Station). Gig. Sanit., No. 5, 99-101(May 1967). (In Russian).

Radiation dose absorption by personnel handling portable γ-defectoscopes with ^{137}Cs and ^{75}Se sources was measured using IV-2.3 detectors. The tabulated data showed that the absorbed dose in examined personnel was 1.5 to 2 fold below the maximum permissible levels per month of exposure. The irradiation of the body at the pelvis level was 1.2 times and at the knee level 1.5 times higher than at the chest. However, the maximum permissible dose of the feet and the total body including the gonads was 600 and 100 mbarn. During the source recharge with ^{75}Se activity

of 0.5 g-equiv Ra, the total dose within the pelvic region was 120 mR and the chest 100 mR. (R.V.J.)

39428 AN INSULATING SUIT WITH AN INDIVIDUAL SYSTEM FOR REGENERATING THE RESPIRATION MIXTURE FOR WORK UNDER CONDITIONS OF RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT. Gorodinskii, S. M.; Shcherbakov, V. L. Gig. Sanit., No. 5, 43-6(May 1967). (In Russian).

An isolating costume provided with a device for regenerating the respiration mixture is used in case of contamination of the environment with radioactive substances and when the use of an insulating suit provided with a hose is impossible. In this suit all the space under the coating serves as a breathing bag; the excess of heat is absorbed by a cotton overalls, sluiced with cold water; the costume itself is made of a light fabric that is easily deactivated. It weighs about 7 kg. It is an effective protection against aerosols and gases (99.9%). The length of continuous work in this set amounts to about 2 hrs. (auth)

39429 RADIO-IODINE FALLOUT IN AUSTRALIAN SHEEP. Melick, R. (Royal Melbourne Hospital); Van Middlesworth, L. Med. J. Aust., 2: 930-2(Nov. 12, 1966).

The thyroid ^{131}I content of Victorian lambs was followed since 1958. Nuclear tests conducted at sites in the Pacific Ocean 4,500 miles from Melbourne in 1958 and 1962 resulted in large increases in ^{131}I content of these glands. The activity appeared five weeks after testing commenced. Russian tests in the Arctic 9,500 miles from Melbourne in 1961 caused a slight but definite increase in ^{131}I content some seven weeks after the first test. The radioactivity found in thyroids of Victorian sheep was very much less than that found in the northern hemisphere, and present for a much shorter time. Iodine-131 measured in thyroids from the southern hemisphere was an insensitive index of ^{131}I contamination from the northern hemisphere. (auth)

39430 ISODOSE CURVE AROUND THE PATIENT TREATED BY RADIUM INTRACAVITARY IRRADIATION. Kuroda, Yoshikazu; Nibuya, Koichiro (Jikei Univ., Japan). Jikeikai Med. J., 80: 39-40(May 1965). (In Japanese).

Intracavitary irradiation with 100 mg of Ra was performed on a patient with uterine cancer and a patient with operated maxillary cancer. Doses around the patients were measured at the height of patient's surface with a dosimeter. In the case of uterine cancer, the isodose curves were nearly circular with the pelvis as the center, although the dose on the foot side was somewhat larger than on the head side. The most dangerous place was the region around the pubic symphysis, the dose rate being about 2000 mR/hr. The dose rate was 25 mR/hr at the head and the feet. In the operated maxillary cancer, the dose was largest around the head with the dose rate of 100 mR/hr; it exceeded 500 mR/hr in the region in contact with patient's head. The reduction of dosage on the lateral side of patient was about one-third in the uterine cancer patient and about one-half in the operated maxillary cancer, of the value, calculated by the inverse square law with Ra as the point source. That the dose in this direction was larger in the maxillary cancer than in the uterine cancer may be due to the difference in γ-ray absorption between the head and the pelvis. From the results, it seems that one must stay away from the pelvic region in uterine cancer patients treated with the intracavitary irradiation, and from the region around the head in the maxillary cancer patients treated with small sources. (TSS) (NSA of Japan)

39431 EFFECTS OF THIRD COMMUNIST CHINESE NUCLEAR TEST. REPORT 2. ON THE RADIOACTIVE RAIN AND ATMOSPHERIC CONTAMINATION OBSERVED IN NIIGATA. Kosaka, Takao; Takizawa, Yukio (Niigata Univ., Japan). Niigata Igakkai Zasshi, 80: 597-9(Nov. 1966). (In Japanese).

Investigations were made on the radioactive contamination of rain and atmosphere, as a part of the comprehensive study of the effects of fallout from the third Communist Chinese nuclear test. Although immediately after the test the fall of highly radioactive particles occurred in a single passage, no high amount of radioactivity was detected in rain water. The complexity of the phenomena in this connection was attributed largely to climatology. As for the atmospheric contamination, the radioactivity was not particularly high as compared with that of normal days; the curve of diurnal changes indicated the existence of atmospheric contaminations from the nuclear test. In general, the contaminations were not remarkable, and this was probably because the intense fallout took place in a short period of time immediately after the test. (NSA of Japan)

39432 EFFECTS OF THIRD COMMUNIST CHINESE NUCLEAR TEST. REPORT 4. NASAL OR ORAL INTAKE OF STRONG RADIOACTIVE PARTICLES IN RABBITS AND MICE. Kosaka, Takao; Takizawa, Yukio (Niigata Univ., Japan). Niigata Igakkai Zasshi, 80: 653-5(Dec. 1966). (In Japanese).

As a part of the comprehensive investigation of the effects of fallout from the third Communist Chinese nuclear test, study was made on whether highly radioactive particles would be taken into the body nasally or orally and also whether they would adhere to the cuticle. Nine rabbits and 100 white rats were exposed to the natural atmosphere. (NSA of Japan)

39433 RADIOACTIVITY CONTROL OF MILK IN THE NETHERLANDS. de Ruig, W. G. (Government Dairy Station, Leiden). Neth. Milk Dairy J., 20: 182-92(1966).

As in other countries, radioactive contamination of air, food, soil, and water in the Netherlands is monitored. This control is divided into an environmental survey to control the general contamination of the biosphere, and a local survey conducted in the areas surrounding the atomic piles. In the present paper data are collected on the strontium-89 and strontium-90 contamination of milk during 1961 to 1965. The mean values found for strontium-90 were 1961: 5.0 S.U., 1962: 10.3 S.U., 1963: 25.8 S. U., 1964: 27.0 S. U., and 1965: 22.0 S. U. (auth)

39434 REDUCTION OF THE ABSORPTION AND RETENTION OF STRONTIUM IN RATS. Kostial, K. (Inst. for Medical Research, Zagreb); Maljkovic, T.; Kadic, M.; Manitasevic, R.; Harrison, G. E. Nature (London), 215: 182(July 8, 1967).

The absorption and retention of dietary strontium can be reduced by supplementing the diet with a mixture of barium and sodium sulphates, calcium phosphates, or sodium alginate. This gives rise to the possibility of remedial measures to protect a population exposed to a high concentration of ^{90}Sr in diet. A study is described to compare the effectiveness of these treatments in rats, employing tracer ^{85}Sr and ^{47}Ca. Details of the technique employed are given, and results tabulated. Decreased retention and absorption of strontium were achieved with only about 30% change in absorption and retention of calcium. Combined therapy with alginate and calcium phosphate gave the greatest reduction in strontium absorbed and retained that was obtained from any dietary supplementation studied. (UK)

39435 SIMPLE INSTALLATION FOR THE MEASUREMENT OF LOW-ENERGY BETA RADIATION. Vodros, D.; Gyenge, Gy.; Miklos, K. Orv. Hetilap., 108: 310-11(Feb. 12, 1967).

A low-energy installation for the measurement of β radiation was constructed. The elements of the apparatus and the supplementary parts are described. The measuring installation, which is not yet manufactured in Hungary, has been in use for 2 years and, on the basis of the results, it is considered suitable for tritium as well as ^{14}C, ^{35}S and ^{45}Ca tracer studies. (JPRS)

39436 PROCEEDINGS OF THE 21ST INDUSTRIAL WASTE CONFERENCE, MAY 3, 4, AND 5, 1966, PURDUE UNIVERSITY, LAFAYETTE, INDIANA. PART ONE. Purdue Univ., Eng. Bull., 50: Ext. Ser. No. 121, 1-638(Mar. 1966). (CONF-660523-(Pt.1)).

Prints of 53 of the papers presented at the conference are included in Part I. An abstract was prepared for one paper. Papers for which no abstracts were prepared are concerned primarily with sanitary waste. (J.R.D.)

For an abstract of the individual section see: 39338.

39437 ASSAY OF ^{90}Sr IN HUMAN BONE IN THE UNITED KINGDOM, RESULTS FOR 1966, PART 1. Medical Research Council. London, H.M.S.O., 1967. 14p. 2s. 0d.

Summaries are given of data obtained in UKAEA national survey assays, and assays made at the Royal Hospital for Sick Children and the Regional Physics Department, Glasgow, Scotland. It is noted that hitherto there has been little, if any, difference between the concentrations of ^{90}Sr in the various bones of the skeleton during growth in infants, children and adolescents. A difference has, however, been observed between adult vertebrae and femora, attributed to different rates of turnover in these bones after growth has ceased; the data indicated that ^{90}Sr was concentrated by a factor of 2 to 3 more in vertebrae than in femoral samples. The highest values appear to occur over the age range 6 to 23 months. Results for infants and young children indicate a trend to lower values than in preceding years. (UK)

39438 METHOD AND SOLUTION FOR DECONTAMINATION. (to U.S. Atomic Energy Commission). French Patent 1,407,944. June 28, 1965. Priority date Sept. 19, 1963, United States.

Steel or Zr coolant circuits of nuclear reactors are decontaminated with an aqueous solution that contains the following constituents: 2.3 g/l $H_2C_2O_4$, 32 g/l $Na_2C_2O_4$, 15 g/l M_2O_3, 1 g/l 8-quinolinol and 12.5 g/l of a 40% peracetic acid solution or 5 to 40 g/l Na gluconate + 2.5 to 20 g/l gluconic acid. (NPO)

39439 DECONTAMINATION OF MATERIAL THAT IS CONTAMINATED WITH URANIUM. (to CEA). French Patent 1,349,436. Dec. 9, 1963. Filed Apr. 18, 1962.

Parts of a gaseous diffusion plant contaminated with UO_2F_2 and

possibly with UF_4 are decontaminated with one of the following solutions: a solution of 25 g/l $Al_2(SO_4)_3$, adjusted to pH 2 by adding H_2SO_4, nitric acid (1 to 10 g HNO_3/l), solutions of Na_2CO_3 (5 to 50 g/l), especially for stainless steel parts, or solutions of $(NH_4)_2C_2O_4$, especially for decontaminating parts of Al–Mg alloys. An oxidizer, such as $Fe_2(SO_4)_3$ or air, may be present to promote transformation of U (IV) to U (VI), or the transformation can also be effected by a preliminary treatment with ClF_3. All solutions are regenerated after use with an ion-exchanger that absorbs U, e.g. Dowex 21-K or Amberlite Ira 40. The resin bed is periodically eluted. It is recommended that the parts be degreased with trichloroethylene prior to the decontamination treatment in order to preserve the efficiency of the ion-exchange bed. (NPO)

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Refer also to abstracts 38898, 38954, 39142, 39424, 39494, and 40314.

39440 (AD-632595) REVIEW OF COMBINED TRAUMA: RESEARCH, CLINICAL MANAGEMENT, AND PLANNING. Williams, Dean W.; Duggar, Benjamin C.; Burger, Edward J.; Chamberlin, Harry S. (Bio-Dynamics, Inc., Cambridge, Mass.). Jan. 1966. Contract OCD-OS-63-141. 174p. CFSTI.

The review covers the topic of combined trauma including radiation injury plus burns, physical injury, and/or infection. Since this class of casualty is almost exclusively the product of nuclear weapons effects, the emphasis of the review is on principles of clinical management. Major sections of the review include a casualty model, generated to assess the significance of combined trauma relative to other forms of injury; a review of clinical management principles for care of combined trauma patients; clinical guides to the care of radiation, burn, and infection casualties; a review of the recent combined trauma research; and a summary of planning measures designed to assist in preparedness for disaster medical care. An extensive bibliography is also included. (TAB)

39441 (AD-640921) EFFECTS OF OVERPRESSURE ON THE EAR. Hirsch, Arthur E. (David Taylor Model Basin, Carderock, Md.). Aug. 1966. 14p. CFSTI.

Tolerance levels of the human ear to various types of overpressure are discussed. (auth) (TAB)

39442 (HSR-RR-67/8-Sd) FEASIBILITY OF DEVELOPING STANDARD DESCRIPTIONS OF POST-ATTACK SITUATIONS. Nordlie, Peter G. (Human Sciences Research, Inc., McLean, Va.). June 1967. Contract OCD-PS-65-29. 33p.

The objective of the study was to evaluate the feasibility of developing a particular methodological tool to aid in conducting research on post-attack phenomena. All such research faces the necessity of studying phenomena in hypothetical future situations. To aid in solving the many problems this fact poses, the concept was advanced of a set of standard situational cases reflecting the range of situations nuclear attacks could create. The study was initiated to determine if the concept of the standard situational case offered sufficient promise for development as a practically applicable research tool. It was concluded that development of the original concept of the standard situational case was not feasible primarily for two reasons: the initial inability to provide criteria for distinguishing between relevant and irrelevant information; and the failure to find means for reducing the cases to a manageable number. However, from a number of the insights gained in the course of the study, a new concept was developed different from, but aimed at the same objectives, as the standard situational case concept. This new concept followed from the realization that the definition of recovery would provide criteria for testing the relevance of information about post-attack situations. The remainder of the study was devoted to further development of this new concept of defining critical information categories for post-attack situations. Developing this set of categories involves two basic steps: first, the specification of a set of recovery goals; and second, the delineation of the factors on which the achievement of each goal depends. The concept was partially developed in this report, and the tasks yet required to develop the concept into a fully operational research tool are outlined. (auth)

39443 (NASA-CR-856) CLINICAL SPACE MEDICINE: A PROSPECTIVE LOOK AT MEDICAL PROBLEMS FROM HAZARDS OF SPACE OPERATIONS. Busby, Douglas E. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex. Dept. of Aerospace Medicine and Bioastronautics). July 1967. Contract NASr-115. 434p. CFSTI.

The following hazards of radiations to be expected in the space environment are discussed and evaluated: trapped (Van Allen) radiation; artificial radiation belts; galactic cosmic radiation; radiation sources on spacecraft; solar electromagnetic radiation; and solar particulate radiation. The clinical picture following a highly penetrating exposure in the LD_{50} range is described. The initial, latent, bone marrow depression, and recovery phases are characterized. Diagnosis, prevention, and treatment of acute radiation effects are discussed. The pathology, diagnosis, and treatment of the following medical problems of space operations are described: acute hypoxia; ebullism syndrome; explosive decompression injuries; decompression sickness; aerotitis media and aerosinusitis; heat disorders; cold injury; hypothermia; medical problems owing to particle and droplet contamination of the spacecraft cabin atmosphere; urinary calculus; injuries from meteoroid penetration; thermal burns; injuries from mechanical forces; and carbon dioxide toxicity. (H.L.W.)

39444 (NEIC-RR-24) RAPORT Z PRAC BADAWCZYCH PROWADZONYCH W 1965 ROKU. (Report on the Research During 1965). Jasinskiego, W. (Instytut Onkologii, Warsaw (Poland)). 1966. 97p. (In Polish). Dep.

Research projects in the areas of epidemiology, oncology, pathology, radiobiology, x-ray diagnosis, and allied subjects carried out in Poland during 1965 are outlined. A bibliography consisting of 88 references is presented; abstracts are included. (R.V.J.)

39445 (NYO-3319-11) RELATIONSHIP OF ULTRAVIOLET AND X-RAY RESISTANCE IN MICROCOCCUS RADIODURANS. Bruce, A. K. (State Univ. of New York, Buffalo. Dept. of Biology). [1966]. 10p. (CONF-660212-12). Dep. CFSTI.

From Radiation Research Society, 14th Annual Meeting, Coronado, Calif.

Micrococcus radiodurans, which is resistant to both uv and x radiation, was found to contain an extractable, low-molecular-weight component, p-hydroxymercuribenzoate (HMB), that affects radiosensitivity. The effects of x and uv radiation on the ability of HMB to bind -SH groups were measured in cells incubated in HMB, washed, and assayed by neutron activation analysis titration of -SH groups. X radiation produced an exponential decrease in the binding ability of HMB whereas uv had no effect. Possible reaction mechanisms involved are discussed. (C.H.)

39446 (NYO-3777-7) PROGRESS REPORT I [ON CANCER RESEARCH], MAY 1, 1966–APRIL 30, 1967. Warren, Shields (New England Deaconess Hospital, Boston, Mass. Cancer Research Inst.). Contract AT(30-1)-3777. 51p. Dep. CFSTI.

LIFE SPANS—radiation effects on, of dentists, pathologists, and radiologist
RADIOISOTOPES—use in diagnosis of malignant neoplasms in man, scanning device for
PARABIOSIS—radioprotective effects of, on rats, whole-body x
CHROMOSOMES—radioinduced aberrations in, of leukocytes in Marshall Islanders, fallout
FALLOUT—effects on chromosomes in leukocytes of Marshall Islanders, aberrant
GAMMA RADIATION—effects on incidence of carcinomas in esophagus, chronic
LEUKEMIA—radiation effects on incidence of, in mice, low-level ambient; radiation effects on incidence of, in populations of man undergoing therapy for cancer of uterus
BENZANTHRACENE—7,12-dimethyl, effects on regulation of enzymes in liver of rats
ADRENAL GLANDS—pathology of, effects of 7,12-dimethylbenz(α)anthracene on
PLUTONIUM—effects on bones of mice, carcinogenic and pathological
CARCINOGENESIS—etiology and pathogenesis of, in man
THYMIDINE—metabolism in cervical tissues of man, autoradiographic study of
TRANSPLANTS—effects on thymidine uptake by parenchymal cells of liver in hamsters, neoplastic
URIDINE—2′-DEOXY-5-(TRIFLUOROMETHYL)-, effects on embryos of chickens, teratogenic
PURINES—effects on fetuses of rats, histopathological study of teratogenic
SELENIUM—effects on hematopoiesis in embryos of chickens; effects on development of embryos of chickens, teratogenic
COBALT CHLORIDES—effects on hematopoiesis in embryos of chickens, pathological
X RADIATION—effects on testes of mice, genetic
BIBLIOGRAPHIES—on radiobiological publications from New England Deaconess Hospital, 1966 to 1967
AUTORADIOGRAPHY—uses in neuropathology, review of
IODINE-131—effects on thyroid glands of mice, effects of thymectomy on neoplastic

MICE — radiation effects on litters of, effects of pre- and postnatal exposure on (B.H.S.)

39447 GAMMA-THERAPY OF RETICULOSARCOMA OF THE BONES. Kozlova, A. V.; Lebedeva, I. A. Med. Radiol., 12: 26-31(Jan. 1967). (In Russian).

An analysis of clinical observations over 18 patients suffering from solitary reticulosarcoma of the bones is presented. As the principal mode of therapy the group was subjected to distance gamma-therapy, with focal doses ranging from 6,500 to 7,000 RAD. An immediate therapeutic effect was achieved in almost all cases. After the end of radium therapy a number of patients was subjected to cytostatic treatment with endoxan. The majority of patients were in a satisfactory state in a follow-up period of 1 to 2 years. The least favorable was the course of treatment in affected patients receiving combined therapy. (auth)

39448 RADIOSENSITIZING EFFECTS OF METHYL ETHYL KETONE DIPEROXIDE DURING X IRRADIATION OF ALBINO RATS WITH LYMPHOSARCOMA. Tiunov, L. A.; Smirnova, O. I.; Kachurina, N. A.; Menshikova, Z. I. Med. Radiol., 12: 91-2(Jan. 1967). (In Russian).

Radiosensitizing effects of methylethyl ketone diperoxide (DMEK) during x irradiation of the Pliss lymphosarcoma induced in white male rats weighing 150 to 180 g were investigated. The results of the experiments showed that DMEK inhibited the catalase activity in the liver and in the malignancies of the animals. These results were interpreted as indirect effects of radiosensitization. In addition to radiosensitization effects the DMEK exhibited some therapeutic effects. Injuries to membranes by lysis due to organic peroxides can induce enzyme movement from the intracellular structure, which in turn can cause degradation of malignant cells and thus enhance the effects of radiation therapy. (R.V.J.)

39449 THE LIMITS OF THE METHOD OF RADIOINDICATION OF MALIGNANT NEOPLASMS DURING THE USE OF RADIOPHOSPHORUS. Frenkel, V. Kh.; Shchelokova, S. V. Med. Radiol., 12: 42-6(Jan. 1967). (In Russian).

The possibilities of external β-radiometry for determining the differences in ^{32}P accumulation are discussed. Irrespective of the size of the focus, it was shown that foci of radioactivity situated at a depth exceeding 0.6 cm could not be demonstrated even when there was a large accumulation of radioactivity. It was suggested that the use of ^{32}P for diagnosis of malignant tumors might be improved by maximal approximation of the counter to the neoplasm under investigation. (auth)

39450 TREATMENT OF POLYCYTHEMIA VERA. Sandeman, T. F. (Cancer Inst., Melbourne). Brit. Med. J., 1: 509(May 20, 1967).

Comments are made on reports relating to the survival of polycythemia vera patients that were treated with ^{32}P. The assumption that radiation is a poor method of management in these and other malignacies because of the risk of leukemogenesis has been made so often that it is of considerable importance to assess this in terms of worthwhile salvage of patients. It is suggested that most patients, if given the full facts, would choose the ^{32}P method of treatment that gives them a 75% chance of 10-yr survival (using rates corrected for age) as compared with a 55% chance even though the mode of death may be different. This is particularly the case since ^{32}P treatment involves fewer clinic attendances and blood counts, no medication to be forgotten, and, in the author's experience, a much quicker resolution of symptoms of flushing and splenic pain. (BBB)

39451 USE OF NEUTRON RADIATION IN MEDICINE. Nikolaenko, O. K.; Shtan, A. S. Med. Radiol., 11: No. 10, 44-52(Oct. 1966). (In Russian).

A brief review is given of the methods and effectiveness of neutrons in cancer therapy. Clinical data reported by various specialists are briefly discussed. (R.V.J.)

39452 VARIOUS PROPERTIES OF THE IMMUNE APPARATUS OF RADIOCHIMERAS. Zaalberg, O. Brocades. Ned. Tijdschr. Geneesk., 110: 1481-4(Aug. 13, 1966). (In Dutch).

Transplantation of heterologous, homologous, and autologous bone marrow and spleen cells in lethally irradiated animals, and the subsequent state of immunity in the recipient animal are discussed. Experiments with x-irradiated mice are described in which lymphoid and myeloid cells from normal CBA donors were injected in lethally irradiated (CBA × C57Bl)F_1 recipients, which in turn provided transplants to other CBA lethally irradiated recipients. Immune relations were tested in the latter recipients, thymectomized and nonthymectomized. The donor immune apparatus in the surviving mice was in prolonged contact with host antigens. The duration of tolerance developed in the host was dependent on the cell type transferred from a second host. A new immune apparatus was developed from the lymphoid stem cells in the bone marrow; tolerance could be induced only in these cells when excess antigen was present, which was never the case in the new host. When spleen or lymph node cells were added to the injected marrow cells, the population was tolerant and appeared to maintain tolerance in the second host against antigen excess. Two populations of lymph cells appeared to exist, a nontolerant population in most cases. Duration of tolerance in a nonthymectomized host was dependent on the amount of tolerant lymph gland cells added to the bone marrow. The described experiments in irradiated mice illustrated these principles, and the case of an irradiated patient described by Mathe was also referred to in support of the results of animal experiments. (BBB)

39453 RADIATION-IMMUNOLOGICAL PROBLEMS AND EXPERIMENTAL APPLICATION OF TISSUE TRANSPLANTATION INCLUDING BONE MARROW. (HEMATOLOGICAL ASPECTS). Stirmai, E. (Technische Hochschule, Stuttgart); Hajdukovic, S. Haematologica (Pavia), 52: 321-43(1967).

Progress in the use of bone marrow to restore hematopoiesis in animals exposed to lethal doses of ionizing radiation is reviewed with 97 references. The occurrence of secondary disease and immune reaction after the bone marrow transplantation in animals is discussed. Following a whole-body lethal exposure and 30 days after homologous or heterologous bone marrow transplantation, hematopoiesis may be restored, but the general condition may deteriorate and this may be followed by the death of the animal. This secondary disease is characterized by cachexia, loss of weight, diarrhea, lymphopenia, and susceptibility to infection. In the typical instance, there are atrophy and fibrinoid necrosis of the lymphatic tissue. Splenectomy and injection of ACTH before lethal irradiation have been used as a means of minimizing the host's reaction to transplanted foreign marrow, but this may also prevent acute radiation death. Homologous fetal liver may reduce the incidence of foreign bone marrow reactions and the consequential late deaths. Sublethal doses of whole-body irradiation to the homologous bone marrow donor mice shortly before collection of the marrow for transplantation into lethally irradiated recipients cause reduction in mortality from secondary disease. Thus a proportionately larger number of antibody-forming cells are destroyed in comparison to blood-forming elements. Use of bone marrow grafting in irradiated humans is also reviewed. (BBB)

39454 COMPARATIVE DOSIMETRIC CHARACTERISTICS OF METHODS OF DISTANCE IRRADIATION OF THE HYPOPHYSIS BY MEANS OF LARGE AND SMALL FIELDS. Stavitskii, R. V.; Slavin, L. G. Med. Radiol., 12: 10-14(Jan. 1967). (In Russian).

Comparative characteristics of conditions of irradiation of the hypophysis and surrounding tissue during roentgen and gamma-therapy with fields of 3 × 3 and 6 × 8 cm are presented. The comparison was carried out by confronting the focal and integral doses of irradiation. It was shown that when it was necessary to use a dose of 6,000 to 7,000 rad in the hypophysis gamma-radiation should be used. In instances where a dose of 2,000 to 2,500 rad was adequate it was possible to use x radiation. (auth)

39455 EFFECT OF SMALL DOSES OF GLUCOCORTICOIDS ON SEVERE RADIATION SICKNESS. Rogozkin, V. D.; Fedotov, V. P.; Chertkov, K. S. Med. Radiol., 12: 89-91(Jan. 1967). (In Russian).

Tests were conducted to determine the effect of small doses of glucocorticoids in cases of severe radiation sickness. Female guinea pigs weighing 270 to 350 g were exposed to 300 R of γ radiation at 3.5 R/sec. Test animals were given 25 μg of prednisolone and 2.5 μg of dexamethasone orally once daily for 10 days beginning with the 4th day after irradiation. Examination of treated animals indicated a lower death rate as compared to the control group (10% vs 20%), insignificant changes in the amount of 11-oxycorticosteroids in the blood (calculated according to a modified Popens method), a positive effect on hemopoiesis, and the presence of more leukocytes than in control animals. Results supported previous data on the appearance of hypercorticoidism during the period of greatest depression of hemopoiesis and indicated that small doses of glucocorticoids reduced the catabolic and lymphopenic effect that causes postradiation hypercorticoidism. (JPRS)

39456 NEW DIRECTIONS IN THE RADIOTHERAPY OF LUNG CANCER. Sagerman, Robert H. (Columbia-Presbyterian Medical Center, New York). Ann. Otol., Rhinol., Laryngol., 76: 253-6(Mar. 1967).

The experimental basis for use of radiation in treating lung cancer is examined. Radiobiological developments during the last decade have provided a better understanding of the action of ionizing radiation, and enabled changes in the use of radiotherapy in the treatment of lung cancer in three directions: preoperative irradiation, irradiation under high-pressure oxygenation, and intraarterial infusion of chemicals in conjunction with irradiation.

Two radiobiological considerations bearing on use of preoperative irradiation in lung cancer are discussed and reasons as to why radiotherapy should be used before surgery is undertaken are outlined. (TSS)

39457 COBALT-60 TELETHERAPY. Ring, M. Alanna (Holy Family Hospital School of Nursing, Manitowoc, Wis.). Hosp. Progr., 47: 111-18(Aug. 1966).

Nursing care for the effects of irradiation following ^{60}Co treatment is outlined. Since the continuity of the skin or mucous membranes may be broken by radiotherapy, they must be observed closely for changes in appearance, such as color changes, lesions or scaling. It is important to keep the ink-marked skin portals intact until the treatment is terminated. The treatment area should be kept dry and free of powders, metallic ointments and tape, as they may alter the action of radiation. Skin reactions vary according to the area and amount of skin or mucosa treated, total dose given, individual differences, and resistance to injury. If skin reactions occur, most develop around the third week of therapy, but skin reactions due to ^{60}Co teletherapy are usually absent or minimal. Minimal reactions include dry erythema and desquamation. The irradiated patient must maintain a good nutritional status to combat undesirable reactions that might be produced by radiation therapy. Good nutritional status also includes an adequate fluid intake because if the body is well hydrated there is less likelihood of skin irritations. A high protein diet is essential during and after radiotherapy because of the tissue breakdown. Precautions must be taken against potential sources of infections since lowered resistance occurs due to reduced white blood cell levels. (BBB)

39458 RADIATION THERAPY AND ORAL CARCINOMA. RADIATION RESPONSE AND EXFOLIATIVE CYTOLOGY. Silverman, Sol Jr.; Sheline, Glenn E.; Gillooly, Charles J. Jr. (Univ. of California, San Francisco). Cancer, 20: 1297-1300 (Aug. 1967).

Cytologic radiation changes and clinical tumor responses were compared in 84 patients with oral squamous carcinoma treated with ionizing radiation. These patients were observed for 1 to 7 years following therapy. Correlation between cellular morphologic changes (RR) and tumor response was not apparent. Persistence and reappearance of malignant-appearing cells were helpful supplements in assessing the presence or absence of tumor and, occasionally, in selecting biopsy sites. (auth)

39459 ON THE QUESTION OF X-RAY THERAPY IN NON-TUMOROUS DISEASES. Pape, Rudolf (Wilhelminenspital der Stadt, Vienna). Roentgen Bl., 18: 193-9(May 1967). (In German).

The literature is reviewed relating to the doses used and the contraindications for x-ray treatment of benign conditions. Recommendations are given for keeping healthy tissue and gonadal exposure to a minimum, and thereby preventing side-effects of x ray therapy. It is suggested that it is in the interest of the patient to restrict the dose to the lower limit of effectiveness in x ray therapy of nonmalignant diseases. Provided the directives outlined here are adhered to, it is suggested, the risk of applying an ineffective method or of being forced to discontinue x ray therapy of inflammatory conditions even in juveniles can be avoided. Instead, the methods described provide for successful therapy, with lower genetic doses than in, e.g., a gastrointestinal examination by x rays. In the x ray therapy of spondylitis in older persons, it is important not to increase single doses beyond 20 R, due to the fact that, in the irradiation of large sections of the vertebral column, extensive portions of bone marrow may be affected. This review shows that low-dose x ray therapy is valid for nonmalignant processes if commonly used dose reduction methods, which favorable clinical experience and experimental studies have proven feasible, are used. (BBB)

39460 UPTAKE AND SCANNING OF THE SALIVARY GLANDS IN MAN USING PERTECHNETATE ^{99m}Tc. Harden, R. McG.; Hilditch, T. E.; Kennedy, I.; Mason, D. K.; Papadopoulos, S.; Alexander, W. D. (Western Infirmary, Glasgow). Clin. Sci., 32: 49-55(Feb. 1967).

The uptake of ^{99m}Tc by salivary glands was studied preliminary to developing a technique for scanning of the glands. Technetium-99m is an almost ideal scanning agent: its short half-life (6 hr) coupled with the near absence of particulate radiation permits relatively large doses to be administered with little hazard to the patient and the 140-keV γ radiation is convenient for scanning. Well-defined scans can thus be completed quickly. It was shown that pertechnetate-^{99m}Tc is concentrated by the salivary glands as by the thyroid gland in man. The results showed that the uptake by the submandibular, parotid, and thyroid glands can be quantitated using a radioisotope scanning procedure. At 30 to 35 min the thyroid gland uptake was significantly higher than that of any one salivary gland but the uptake by the 4 salivary glands frequently exceeded the thyroid uptake. The isotope was completely discharged from the salivary glands 20 to 25 min after potassium perchlorate administration. Some radioactivity was present centrally in the mouth region and presumably due, at least in part, to adsorption of the isotope onto the oral mucosa. Scans, using ^{99m}Tc, to locate tumors in this region can be interpreted in the light of these findings. (BBB)

39461 RADIOACTIVE ISOTOPES IN CLINICAL MEDICINE. I. Havard, C. W. H.; McAlister, Joan (St. Bartholomew's Hospital, London). Brit. Med. J., 1: 487-91(May 20, 1967).

Theoretical and practical bases of the use of radioisotopes in medical diagnosis are presented, with attention to the characteristics of the fundamental particles of nuclear physics, types of radiation emitted by radioisotopes, and measurement of radioactivity. Various types of counting apparatus are described and their use in different diagnostic procedures outlined. Whole-body counters make it possible to measure the total radioactivity in the body, and these are of great value in absorption studies. Another development has been that of more sensitive scanning devices, which are used in studying the distribution of radioactive isotopes in various organs and tissues. Furthermore, the recent production of isotopes with shorter lives has made it possible to give higher radioactive doses without increasing the radiation hazard. This is of particular advantage to the scanning techniques, which now enable most organs of the body to be visualized. (BBB)

39462 NEUTRONS AGAINST CANCER. Morgan, R. L.; Bewley, D. K.; Vonberg, D. D.; Morrison, R. (Hammersmith Hospital, London). Brit. Med. J., 1: 241(Apr. 22, 1967).

Design of neutron generators for radiotherapy and problems of side-effects of neutron irradiation are considered. The Baldock neutron generator tube is discussed. It is difficult to increase the output of D-T (deuterium-tritium) tubes, and the Baldock tubes with their present output of 10^{11} neutrons/sec and a tube life of the order of ~100 hr are considerably better than some tubes of other types. However, these tubes are too weak for realistic neutron therapy. The dose rate at the patient's skin, at 70 cm from the target (probably the minimum distance that will be practicable), would be about 0.5 rad/min requiring 200 min per treatment. A tube now being designed would give 30 times this output; if successful this would give a treatment time of 5 or 10 min. It is pointed out that collimation of fast neutrons requires a large thickness of iron or similar material, and the engineering problems of making a fully maneuverable unit are great. In early studies many serious late sequelae of neutron treatment were observed, but despite the selection for the trial of patients with advanced malignant disease considered incurable by conventional means, in many cases the tumors were eradicated in the treated areas. Explanation of the cause of the late sequelae is suggested on the basis of experiments with pig skin. This work was more recently extended to human skin and the findings with pig skin have been confirmed. A preliminary therapeutic trial of fast neutrons was commenced and a few patients were treated. A high neutron output enabled use of a target-skin distance of 125 cm with a dose-rate of about 30 rad/min giving treatment times of about 5 min. The mean neutron energy of 6 MeV was less than that of the generator discussed above (14 MeV), leading to lower penetration, but this was offset to some extent by an improvement in penetration brought about by the increased treatment distance. (BBB)

39463 RADIOXENON BRAIN SCANNING WITH THE GAMMA-RAY SCINTILLATION CAMERA. Rosenthall, Leonard; Mathews, George; Stratford, Joseph (Montreal General Hospital). Radiology, 89: 324-8(Aug. 1967).

Radioxenon brain scans were performed in a variety of brain lesions. The gas was administered either through inhalation or a carotid injection of the gas dissolved in saline. Comparative studies with macroaggregates of radioiodinated albumin show that xenon may diffuse into a blood clot or necrotic tumor tissue. Blood flow values calculated from desaturation curves obtained over these areas may be misleading. The xenon scans uncovered lesions which were missed with conventional radiopharmaceutical test agents. More satisfactory scans were obtained with the carotid injection of ^{133}Xe solution than with the inhalation pathway. (auth)

39464 IMPLANTABLE ^{252}Cf NEUTRON SOURCES FOR RADIOTHERAPY. Wright, C. N.; Boulogne, A. R.; Reinig, W. C.; Evans, A. G. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Radiology, 89: 337-9(Aug. 1967). (DP-MS-67-8).

Implantable neutron sources of californium-252, an intense neutron emitter, are being developed for possible application in radiotherapy. A needle containing 1 microgram of ^{252}Cf yields dose rates equivalent to 1 milligram of radium. (auth)

39465 SELDINGER CATHETER IN RADIATION THERAPY. Steckel, Richard J.; MacLowry, James D.; Holland, James M.; Paulson, David F.; Johnson, Ralph E. (National Cancer Inst., Bethesda, Md.). Radiology, 89: 332-5(Aug. 1967).

The infusion of small amounts of epinephrine into the renal artery of dogs before and during exposure of the kidney to radiation delivered at 1,500 rads in a single dose resulted in the preservation of renal integrity and function. Epinephrine-induced vasoconstriction caused a marked decrease in the renal blood flow and resulted in temporary renal anoxia that produced a striking radioprotective effect on the kidney. Epinephrine infusion technique was applied experimentally in one patient undergoing radiotherapy of advanced abdominal cancer. (C.H.)

39466 PLACENTAL SCANNING WITH SODIUM PERTECHNETATE ^{99m}Tc SERUM ALBUMIN. Johnson, Philip M.; Sciarra, John J.; O'Leary, James A. (Columbia-Presbyterian Medical Center, New York). Radiology, 89: 321-3(Aug. 1967).

High-resolution scintillation scanning of the placental blood pool was performed in 36 gravid patients, using sodium pertechnetate ^{99m}Tc bound to human serum albumin. The placental site was correctly identified in 34 patients, including 6 or 7 in whom placenta previa was subsequently demonstrated. Placental scanning appears comparable in accuracy to conventional isotopic placental localization by multiple point counting and provides, in addition, useful information as to placental size and morphology. (auth)

39467 ELECTRON-BEAM THERAPY OF CANCER OF THE BREAST. Chu, Florence C. H.; Nisce, Lourdes; Baker, Alan S.; Sattar, Abdul; Laughlin, John S. (Memorial Hospital for Cancer and Allied Diseases, New York). Radiology, 89: 216-23(Aug. 1967).

The program to investigate the role of high-energy electron-beam therapy in the management of breast cancer was initiated at Memorial Hospital in 1955. The 24-MeV betatron was used to produce electron beams in the energy range of 6 to 24 MeV. During this eleven-year period, 549 patients received 1,283 separate courses of electron-beam therapy for inoperable, postoperative, recurrent, or metastatic breast cancer. Electron-beam therapy proved advantageous in many respects of the treatment of certain types of breast cancers. The techniques are versatile and, usually, simple to use. The treatment plan can be tailored to meet the individual's situation and needs. In particular, electrons are effective in delivering a satisfactory tumor dose without injuring the underlying normal tissues. Comprehensive treatment-planning, including consideration of inhomogeneities, has proved essential, although it does require time, effort, and considerable knowledge of anatomical detail. The influence of considerations of biological effectiveness has been discussed. The basis for a dose-distribution efficiency factor expressed as a ratio of tumor dose in rads to total energy absorbed in ergs has been given with application to specific cases. The indications for and methods of electron-beam treatment are described, and the results of treatment are presented. On the basis of this eleven-year study, it is concluded that high-energy electron-beam therapy definitely occupies an important place in the radiotherapeutic management of breast cancer. (auth)

39468 CLINICAL EVALUATION OF THE ADJUNCTIVE USE OF HYDROXYUREA (NSC-32065) IN RADIATION THERAPY OF CARCINOMA OF THE LUNG. A COMPARATIVE STUDY. LePar, E.; Faust, D. S.; Brady, L. W.; Beckloff, G. L. (Hahnemann Medical Coll., Philadelphia). Radiol. Clin. Biol., 36: 32-40 (1967).

The use of hydroxyurea as an adjunct to definitively administered supervoltage x radiation therapy in the treatment of carcinoma of the lung in a group of twelve patients produced a median survival of 10 months, as compared to a median survival of 9.5 months in a group of fourteen patients randomized to be treated definitively by supervoltage therapy alone. The side effects were not greater in the group receiving hydroxyurea and supervoltage irradiation, as compared to the groups receiving supervoltage irradiation without the concomitant administration of hydroxyurea. A group of eight patients with carcinoma of the lung who met the criteria for pre-operative supervoltage radiation therapy followed by surgery had a median survival of 13 months and are included for comparison with the above randomized groups of patients. A group of sixteen patients who were treated palliatively with supervoltage therapy had a median survival of only 3.5 months. (C.H.)

39469 PITUITARY IRRADIATION FOR CUSHING'S SYNDROME. Heuschele, R.; Lampe, I. (Univ. of Michigan, Ann Arbor). Radiol. Clin. Biol., 36: 27-31(1967).

In 16 patients with Cushing's syndrome due to adrenal hyperplasia produced by excessive secretion of ACTH, pituitary irradiation (4000 R γ in 4 to 4.5 weeks) was followed by complete remission of all the manifestations of the syndrome in 10 patients. This experience and that reported in the literature substantiate the usefulness of this kind of treatment. (auth)

39470 THE COMBINED TREATMENT FOR CARCINOMA OF THE ESOPHAGUS WITH THE RADICAL RESECTION AND THE PREOPERATIVE IRRADIATION. Akakura, Ichiro; Nakamura, Yoshizo (Keio Univ., Tokyo). Keio J. Med., 14: 145-57 (Dec. 1965).

Preoperative irradiation has been carried out since 1963 with the purpose of increasing the resectability rate for the patients with carcinoma of the esophagus and minimizing local recurrence after resection. Forty-two patients were irradiated with telecobalt or linear accelerator before radical resection. The total tumor dose of 5000 to 6000 rads was given over 4 to 5 weeks, with daily doses of 150 to 250 rads or 400 rads on alternate days. The radical resection was performed a month after the end of the preoperative irradiation. Preoperative irradiation reduced the extent of the tumor and made it possible for the majority of patients to undergo the radical resection; the persistent cancer cells at the resected stump and the periesophageal tissue were also reduced. The resectability rate was increased from 44% in the non-irradiated cases to 88% in the irradiated ones. The radical resectability rate (curative resection rate) was drastically increased from 50% in the non-irradiated patients to 86% in the irradiated ones. Preoperative irradiation did not have any detrimental effect upon the patients. The operative mortality rate was decreased from 17% in the non-irradiated patients to 10% in the irradiated patients, despite the application of a radical resection for the advanced cases. The 2-year survival rate was 25% in the non-irradiated patients, while that of the irradiated patients 46%. (NSA of Japan)

39471 RADIATION HAZARD AND CHEMICAL PROTECTION AGAINST RADIATION. Seregely, Gyoergy. Gyogyszereszet, 10: 163-73(May 1966). (In Hungarian).

A review is presented of literature on the development of chemical compounds for the prophylaxis and treatment of radiation sickness and protection against radiation injuries. (53 references.) (C.H.)

39472 USING CYCLOTRON-PRODUCED ISOTOPES AT HAMMERSMITH HOSPITAL. Clark, J. C.; Matthews, C. M. E.; Silvester, D. J.; Vonberg, D. D. (Hammersmith Hospital, London). Nucleonics, 25: 54-62(June 1967).

The uses of a wide variety of accelerator-produced radioisotopes for new applications in nuclear medicine are described. The advantages of accelerator-produced radioisotopes over reactor-produced ones for use in clinical studies are described. Medical applications of 40 accelerator-produced radioisotopes, and data on their method of production and decay mode are tabulated. (60 references.) (C.H.)

39473 LUNG VISUALIZATION AND FUNCTIONAL EVALUATION BY TWO NEW RADIOISOTOPE SCANNING METHODS. Taplin, George V.; Dore, Earl K.; Poe, Norman D.; Greenberg, Alfred; Johnson, Delores E. Contract AT(04-1)-GEN-12. Excerpta Med. Int. Congr. Ser., No. 105, 1194-1207(Sept. 1965).

The development of a safe technique for visualizing the lower respiratory tract by chest scanning following inhalation of ^{198}Au- or ^{131}I-labeled aerosols is described. The aerosolization equipment and test agents are readily available. Filtration of the exhaled air and channeling it to a vented hood or to the outside atmosphere prevents contamination of the examining room and personnel. Normally, inhaled radioactive particles smaller than 1 to 2 μ are evenly distributed throughout the lungs and penetrate to the distal alveoli. Inhalation and intravenous lung scans have nearly identical patterns in normal subjects. The inhalation scan pattern represents the distribution of airborne particles deposited throughout the lower respiratory tract but the amount of radioactivity in any given portion of the lung is not always proportional to air flow to that region. Aerosol deposition is related to factors other than diffusion such as particle size, sedimentation, impaction, concentration of aerosol and the rate of air movement. When inhalation is performed with the subject in the lateral position, greater amounts of aerosol are deposited in the superior lung where ventilation and perfusion are reduced. With partial bronchial obstruction, increased deposition of radioaerosol may occur at the obstruction site and the region beyond usually shows reduced levels of radioactivity. Complete bronchial obstruction is readily detectable in the inhalation scan as an area devoid of radioactivity and a normal lung image indicates patency of the lower respiratory passages. The radioaerosol inhalation scanning procedure is a useful adjunct to bronchography in the assessment of airway patency. It may be employed safely when bronchography is contraindicated as in patients with impaired pulmonary function. The procedure is still in the early stages of development but current experience with it warrants further investigation and technical improvements. (auth)

39474 RADIOPROTECTIVE ACTION OF NON-IONIC SURFACTANTS ON E. COLI B/r. Titani, Yoiti; Katsube, Yutaka (Shionogi and Co., Ltd., Osaka). Radioisotopes (Tokyo), 16: 323-5(July 1967).

When E. coli B/r was irradiated in well air-equilibrated phosphate buffer at 15°C with 40 KR of ^{60}Co γ rays, the presence of many kinds of water soluble non-ionic surfactants during irradiation increased the survival fraction. Tween 80 was the most protective compound among those surfactants tested, and DRF of 2.5 was obtained at 10^{-1} M while 4.0 was obtained for 0.06 M of β-mercaptoethylamine by our assay system. The protective effect of Tween 80 appeared at 10^{-4} M then increased rather linearly up to 10^{-1} M without reaching plateau. Higher concentration was not investigated because of high viscosity. Long polyoxyethylene chain(s) at the hydrophilic end seems to be effective for the protective action. Possible explanation of the protection mechanism is discussed. (auth)

39475 THE SUPPLEMENTARY CEREBRAL CIRCULATION EXAMINED WITH MAA-^{131}I INTO THE CAROTID IN CASE OF OCCLUSION OF THE NECK. Blandino, G.; Conforti, P.; Armenise, B.; Ascenti, E. (Univ., Messina, Italy). Med. Nucl. Radiobiol. Lat., 9: 549-54(1966). (In Italian).

The close connection between cerebral blood flow and the topographic distribution of macroaggregates of human serum albumin tagged with ^{131}I introduced into the carotid suggested this new scintigraphic method in between tests of substituted cerebral circulation functionality tying of the carotid in the neck. The results are evaluated and reference is made to the advantage of this method over angiography. (auth)

39476 RADIOTHERAPY WITH SOLID SOURCES OF ^{192}Ir. DOSIMETRIC PROBLEMS, INDICATIONS, AND TECHNIQUES FOR TREATMENT OF PHARNYX CANCER. Pierquin, B.; Coopmans de Yaldi, G. (Institut Gustave Roussy, Paris. Univ., Milan). Med. Nucl. Radiobiol. Lat., 9: 477-520(1966). (In Italian).

The characteristics of radioelements that are presently used in interstitial and endocavitary treatments with after-loading technique are briefly reported. As far as dosimetry of artificial elements was concerned, the classical therapeutic planes devised for conventional radiation sources were not applicable even if corrections were made and specific γ-emission was taken into consideration. The fundamentals of a new dosimetric system that integrates the tomographic dosimetric technique, the Paris system, is reported. Finally, the principles of radiotherapy with ^{192}Ir for specific management of epi- and oro-pharynx carcinoma are discussed. (auth)

39477 RADIOPHARMACEUTICAL PRODUCTION AT SQUIBB. Virgona, Angelo. Isotop. Radiat. Technol., 4: 222-6(Spring 1967).

The Squibb radiopharmaceutical processing facility in New Brunswick, N. J., a 27,500 sq ft building specially equipped for processing radioactive drug materials, is described. (auth)

39478 ^{123}I: DEVELOPMENT AND USEFULNESS OF A NEW RADIOPHARMACEUTICAL. Rhodes, Buck A. (Johns Hopkins Medical Institutions, Baltimore); Wagner, Henry N. Jr.; Gerrard, Martha. Isotop. Radiat. Technol., 4: 275-80(Spring 1967).

The properties of ^{123}I, its production, and uses are reviewed. (auth)

39479 A CYCLOTRON FOR MEDICAL AND BIOLOGICAL INVESTIGATION. PART II. CONCEPTION OF A CYCLOTRON [COMPACT-CYCLOTRON] FOR NUCLEAR MEDICINE. Boettger, O.; Mueller, R. W. (AEG-Froschunginstitut, Frankfurt am Main). Atompraxis, 13: 313-15(July 1967). (In German).

The isochronous cyclotron is an ideally suited tool for producing radioisotopes, especially short-lived β^+-emitters. The cyclotrons should have a final energy of around 20 MeV and should be able to accelerate a number of light ions. The most important applications are in nuclear medicine, biology, and chemistry. The principles of construction for this machine are developed. (auth)

39480 RADIATION PROTECTION EFFECT OF CERTAIN ISOTHIURONIUM-S-PROPIO-NN'-DIARYL AMIDINS. Robev, St., Baev, Il.; Panov, N. (Inst. of Radiology and Radiation Hygiene, Sofia). Compt. Rend. Acad. Bulg. Sci., 19: 1143-5 (1966). (In Russian).

Results of radiation protection properties of certain newly synthesized β-isothiuronium-S'-propio-NN'-diaryl amidines in two lines of mice exhibiting differing radiation sensitivity are presented. Tables show the results of toxicity tests carried out on 165 animals and radiation protection capability investigation carried out on 425 animals. Data are compared with those from parallel tests on control and cysteamine-protected animals. (JPRS)

39481 MODERN TRENDS IN RADIOTHERAPY. I. Deeley, T. J.; Wood, C. A. (eds.). London, Butterworths, 1967. 395p. 85s.

Contributions to this volume are as follows – Applications of radiobiology in radiotherapeutic developments – Fractionation in radiotherapy – Oxygen therapy: biological considerations – Oxygen therapy: Clinical experiences – Regional oxygenation by infusion of hydrogen peroxide – Combined therapy using chemotherapeutic agents and radiotherapy – Boron capture therapy – Fast neutron therapy: physical and biological considerations – Fast neutron therapy: Clinical applications – Use of tritium-labeled compounds – Controlled clinical trials in radiotherapy – Treatment by supervoltage machines: linear accelerators – Treatment by supervoltage machines: telecurie apparatus – Treatment by supervoltage machines: Electron beam therapy – Heavy particles in therapy – Management of Hodgkin's disease and allied disorders – Trends in therapy of leukaemia – Therapeutic use of radioactive iodine and phosphorus – Use of pituitary implantation for endocrine diseases – Detection of tumours using short-lived isotopes. (UK)

39482 EXPERIMENTAL EVALUATION OF MEDICAL SCANNERS. Evans, Winfield W. Norman, Okla., Univ. of Oklahoma, 1966. 59p.

Thesis.

A field evaluation at 4 separate medical installations of rectilinear scanners was carried out using a portable 100 channel analyzer and a simple plastic phantom. The scanners included a Picker 3", Ohio Nuclear 8", a Picker 5", and a Nuclear-Chicago 3" Pho Dot. Mercury-197, ^{57}Co, ^{203}Hg, and ^{131}I were used as test sources to cover the energy range of 77 KeV to 364 KeV. A comparison of the 4 scanners and 11 collimators was made using theoretically derived relationships for point, surface, and spherical source distributions. The spectral changes which are associated with defect or tumor localization are graphically presented. (auth)

Radiation Effects on Animals

Refer also to abstracts 39376, 39381, 39403, 39406, 39446, and 39448.

39483 (AD-632812) OBSERVATIONS ON THE BEHAVIOR OF PIGEONS WITH RESTRICTED LESIONS IN THE TELENCEPHALON. Technical Report (Final), App. 2. Fabricius, Eric; Larsson, Borje; Steen, Lennart; Akerman, Bengt (Stockholm Univ. (Sweden). Dept. of Zoology). Oct. 15, 1962. Contract AF61(052)-195. 11p. CFSTI.

In 10 pigeons restricted lesions were made in the telencephalon by means of high energy proton beams. The lesions were situated in the posterior and medial striatum. All the pigeons were normal as regards eating, drinking, and flying. When flying they were able to avoid obstacles and to land normally. The blinking reflexes and the reactions to sounds were normal in all the pigeons. Seven pigeons showed abnormally strong escape responses for 10 to 15 days after the radiation or in one case for all the time after the radiation, while three pigeons were normal. In two pigeons the escape responses disappeared after about 60 days and in one pigeon these responses were very weakened after 55 days. In these three last pigeons, such behaviors were observed, as are otherwise seen in pigeons imprinted to man. These behaviors comprised aggressive pecking, wing vibrating, and nodding. Wing vibrating was also observed occasionally with the pigeon with persisting strong escape responses. Learning experiments with 7 of the pigeons gave the result that two pigeons had a decreased ability of remembering compared with normal pigeons. These two pigeons had lesions in the medial striatum. In none of the pigeons have we seen behavioral changes of the kind seen as symptoms of fully decerebrated pigeons. (TAB)

39484 (AD-635662) EFFECTS OF TELENCEPHALIC RADIOLESIONS ON LEARNING AND RETENTION IN THE PIGEON (COLUMBA LIVIA). APPENDIX II. Final Technical Report. Steen, Lennart (Stockholm Univ. (Sweden). Dept. of Zoology). Nov. 30, 1963. Contract AF-EOAR-62-12. 22p. CFSTI.

Learning experiments were performed with 12 pigeons with restricted telencephalic lesions produced by means of high energy proton beams. The lesions were mainly placed at the level of the anterior commissure or slightly frontal to that level. The results of the learning experiments are discussed together with those of 7 earlier irradiated pigeons. Eleven pigeons showed normal learning ability and retention in comparison to nonirradiated pigeons. Out of the 3 remaining pigeons one showed decreased learning ability, 6 ones decreased retention, and one finally decreased learning ability as well as decreased retention. It is concluded that 4 of the cases with decreased retention may be related to damages in the lateral forebrain bundles while the other cases are

more obscure. The effects cannot with certainty be related to certain telencephalic structures. Neither can they in a simple way be related to the size of the lesions, although larger lesions than those obtained in this material may give other results. Observations on escape responses showed that the radiation brought about changes in this respect in 5 of the pigeons. Increased escape responses are believed to be the effect of shock conditions after the radiation, physiological changes during the development of the lesions, or possibly the situation of the lesions. Decreased escape responses may in one case be related to intersection of the occipito-mesencephalic tracts. Social responses to man were observed in three pigeons, which also showed decreased escape responses. It is suggested that the lesions are responsible for the latter phenomenon and thus they are indirectly related to the development of social responses to man. (auth)

39485 (CONF-650847) PROCEEDINGS OF THE CONFERENCE ON RADIATION BIOLOGY HELD AT THE OAK RIDGE ASSOCIATED UNIVERSITIES, OAK RIDGE, TENNESSEE, AUGUST 2–5, 1965. (Oak Ridge National Lab., Tenn. UT-AEC Agricultural Research Lab., Oak Ridge, Tenn. Oak Ridge Associated Universities, Inc., Tenn.). June 1967. 63p. Dep. CFSTI.

Fundamental principles of radiation biology are reviewed. How information from radiation studies can be incorporated into the undergraduate curriculum in courses such as biology, botany, zoology, genetics, embryology, physiology, and microbiology is discussed and the feasibility of radiation biology courses is evaluated. (C.H.)

39486 (ORO-3578-1) LYSOSOMES AND THE SKIN. Olson, Robert L.; Nordquist, Robert; Nordquist, John; Everett, Mark Allen (Oklahoma Univ., Oklahoma City. Dept. of Dermatology). July 20, 1967. Contract AT(40-1)-3578. 8p. (CONF-670719-1). Dep. CFSTI.

From 13th International Congress of Dermatology, Munich, Germany.

Lysosomes were demonstrated within epidermal cells of human skin. Lysosomal ingestion of ferritin and melanin demonstrated the phagocytic ability of epidermal cells. These organelles frequently contained a variety of structures and substances including melanin and material that would react with periodic acid methenamine (PASM). The effects of uv-radiation on the content of PAS positive material, previously described by light microscopy and ordinarily contained within epidermal lysosomes is described. (B.H.S.)

39487 (ORO-3578-2) PHYSIOLOGICAL RESPONSE OF HUMAN SKIN TO ULTRAVIOLET LIGHT. Everett, Mark Allen; Olson, Robert L. (Oklahoma Univ., Oklahoma City. Dept. of Dermatology). July 20, 1967. Contract AT(40-1)-3578. 9p. (CONF-670719-2). Dep. CFSTI.

From 13th International Congress of Dermatology, Munich, Germany.

Recent research on uv-induced erythema provided much new data regarding the reaction of human skin to ultraviolet light. A review of the studies revealed that in the spectral range of 250 to 310 mμ, cutaneous erythema was directly wavelength dependent; the shorter the wavelength, the less the minimal erythema dose (MED). Time of day and interruption of the light beam does not affect resultant erythema. The energy required to produce erythema was significantly modified by such factors as anatomic location, angle of the incident light, thickness of the stratum corneum, time of observation, and size of the field of exposure. (auth)

39488 (X-67-11855) INVESTIGATION OF THE EFFECT OF IRRADIATION CONDITIONS ON THE NERVOUS SYSTEM OF PERSONS WORKING WITHIN THE REACH OF MICROWAVES. Edelwejn, Zbigniew; Baranski, Stanislaw. Translated from Lek. Wojsk., 42: 781-6(1966). 9p. (NASA-TT-F-10612). CFSTI.

Personnel performing operation, inspection, and repair functions under exposure to microwaves were tested. Exposure varied between 10 $\mu W/cm^2$ to sporadic bursts of several mW/cm^2. Neurological examinations, hyperventilation tests, and Cardiazol tests were performed. Conclusions drawn from results of the study were the following: The frequency of complaints (headaches and dizzy spells, feeling of fatigue, perspiration) among persons working within the scope of microwaves was dependent on the length of the period of employment and the degree of exposure to radiation. Only in the case of persons exposed to relatively large power densities and for a longer period of time, were changes discovered in the electroencephalographic record, consisting of its reduction and a decrease in the percentage of alpha waves. With all the examinees, regardless of the degree of exposure and the period of employment, a poorer-than-the-norm toleration to the intravenous administering of Cardiazol was discovered. After examining 30 persons, the test was discontinued for fear of causing harmful effects. The majority of the examinees showed symptoms of a neurosis-like complex that is close to neurastenic neurosis. The distribution of the symptom frequency of occurrence, as a function of the length of the employment period, seemed to indicate a significant reaction during the first few years of contact with the irradiated surroundings (first three years of employment), then a gradual adaptation, and only after a longer period of time a renewed occurrence of negative effects. (auth)

39489 CHANGES OF MITOTIC ACTIVITY OF THE BONE MARROW AFTER WHOLE-BODY X IRRADIATION IN MICE. Zak, M. (Charles Univ., Prague). Sb. Lekar., 69: 12-16 (1967). (In Czech).

The mitotic activity of bone marrow in mice was studied on the basis of the mitotic index following whole-body irradiation with 200-KV x rays at doses of 100, 300, 600, and 1000 R. The femoral bone marrow was examined cytokinetically at 1, 5, 7, 14, 21, 28, and 30 days after exposure. The supralethal dose (1000 R) caused a progressive inhibition of mitotic activity (10% of normal on the seventh day). Low and medium doses caused biphasic changes in mitotic activity. Within 30 days the activity returned to the normal level after 100 R, and near normal after 300 and 600 R. The low dose (100 R) caused a compensatory rise in mitotic activity. At early time intervals, a rise above levels in animals not exposed to radiation was recorded. Changes in the mitotic index corresponded roughly to the extent of damage of bone marrow, or the dose of radiation administered. Use of the mitotic index as a diagnostic method for assessing the severity of radiation exposure is discussed. (BBB)

39490 RADIATION INJURY AND OPEN SKIN WOUNDS. Messerschmidt, O. (Univ., Freiburg i.B.). Arch. Klin. Exp. Dermatol., 22: 329-35(1966). (In German).

The author presents evidence for increased mortality in mice as a function of time between whole-body x irradiation with and without open or closed skin wounds. Mortality was as high as 80 or 90% in mice, with open skin wounds, x irradiated with a dose of 510 R, as compared with mortalities of 20 or 30% in mice irradiated with the same dose but with closed skin wounds. Uninjured mice irradiated with doses of 100, 200, 300, 450, 510, and 640 R of x rays showed mortalities of 2, 20, and 82%, respectively at the three highest dose levels. However, mice with open skin wounds that received these same doses of irradiation at two days postirradiation showed mortalities in all dose groups. Mortalities amounted to 10, 24, 48, 84, 90, and 100%, respectively. Mortality in mice after administration of 510 R of whole-body x irradiation and skin wound closure immediately after irradiation was ~25%. In mice given the same amount of irradiation, mortality increased up to almost 100%, depending on whether the skin wounds were closed within three or 24 hr, or allowed to remain open. Wound healing was impaired by irradiation with 510 R of x rays. In rats that were given 640 R of whole-body x irradiation, mortality increased from 10 to 92% when three open skin wounds were produced two days after irradiation. The impairment of healing in the irradiated rats was similar to that observed with mice. (BBB)

39491 AFFECTION OF THE THYMUS IN RATS DECEASED AFTER WHOLE-BODY X-RAY IRRADIATION IN LARGE DOSES. Kholin, V. V. Med. Radiol., 11: No. 10, 67-9(Oct. 1966). (In Russian).

Histological studies of the thymus were made of 3 and 4 month old and 9 and 10 day old white rats exposed to 10,000, 25,000, and 50,000 R x radiation. The degree of radiation injury to the thymus depended on the date of death of the animal. A somewhat more pronounced injury of thymus was observed in immature animals as compared to the mature animals exposed to 10,000 R. However, at larger doses no age difference was observed. (R.V.J.)

39492 CASE OF RADIATION SICKNESS DUE TO INTERNAL IRRADIATION. Safronov, E. I.; Shamov, V. P.; Malykhin, V. M. (Inst. of Radiation Hygiene, Leningrad). Med. Radiol., 12: 52-62 (Jan. 1967). (In Russian).

A detailed study of a single fatal case of radiation sickness is presented. The patient swallowed 2.03 mCi of ^{226}Ra in November 1960; after a primary general radiation reaction lasting one month, the course of the illness became chronic. Against the background of chronic radiation sickness selective injury to the blood system and skeleton gradually took shape; and signs of neurocirculatory dystonia of the hypotonic type, accompanied by increasing asthenia, were noted, but the most complete, pronounced, and stable changes were in the blood system. The patient's general condition was satisfactory for three years. The changes noted above became increasingly intense between June 1963 and August 1965 when the patient died. The article gives the results of analysis of the patient's blood covering the entire course of the illness, particularly the initial and terminal stages. Measures undertaken to speedily eliminate the radium from the body and the complex therapy of the radiation sickness proved to be of no value. (JPRS)

39493 THE IMPORTANCE OF RADIATION LOADING ON ORGANS AND TISSUES IN RADIOTHERAPY OF SOME MALIGNANT NEOPLASMS AND LYMPHOGRANULOMATOSIS. Funshtein, L. V.; Vorob'ev, E. I.; Shcherban, E. I.; Gracheva, N. D.; Palladieva, N. M. Med. Radiol., 12: 35-42(Jan. 1967). (In Russian).

By means of microscopical investigation with due consideration to the radiation loading on individual organs and tissues an assessment was made of their state in 48 deceased patients that were treated with x-rays and γ radiation (^{60}Co) for malignant tumors or lymphogranulomatosis. Normal organs and tissues inadvertently irradiated during radiotherapy manifested structural changes often caused by ionizing radiation, and partly caused by the main disease or its complications. Stable alterations in inadvertently irradiated organs, as one of the sources of hypoxia, should be taken into consideration in the mechanism of death among persons undergoing intensive radiotherapy. (auth)

39494 GAMMA-THERAPY OF TUMORS OF THE HYPOPHYSIS. Merkova, M. A.; Lutsker, L. S.; Zhavoronkova, Z. E. Med. Radiol., 12: 19-26(Jan. 1967). (In Russian).

The results of distance gamma-therapy in 52 patients with hypophyseal tumor are presented. Irradiation was conducted from two temporal fields 4 × 4 cm in size. The precise centering was effected by means of lead tags under roentgenographic control of the skull. Focal doses comprised 5,500 to 7,000 rad. In these conditions an insignificant volume of normal cerebral tissues was irradiated, as the result of which the general radiation was not marked and was not observed in all patients. The local reaction in the form of epilation was noted in exposition doses of 5,000 to 5,500 R. Positive results were attained in 84.6% of the cases. This points to the necessity of reviewing the indications to surgical and radiation treatment of hypophyseal tumors in order to widen the indications to gamma-therapy, as an independent mode of therapy. (auth)

39495 THE INFLUENCE OF X-RAY IRRADIATION ON THE EXPERIMENTAL GROWTH OF BONES. Safarov, A. M.; Shtern, S. V. Med. Radiol., 12: 62-7(Jan. 1967). (In Russian).

The right knee joints of 56 puppies, aged from 1½ to 6 months were subjected to distant irradiation. In all puppies a course of irradiation was effected, however in different groups various single and course doses were employed. In puppies subjected to a course irradiation of 3000 R an insignificant shortening of the irradiated extremity was noted. Apart from this, in the irradiated bones certain structural changes were revealed which were of a reversible nature. A repeated course of irradiation with similar doses caused less change, since it was performed at an older age. The difference in the rate of bone growth in puppies and children was taken into account and the dose was reduced to 160 R per course. In these puppies no alterations were revealed. (auth)

39496 DISTRIBUTION OF AMINO ACIDS BETWEEN ERYTHROCYTES AND PLASMA IN BLOOD OF PATIENTS TREATED WITH RADIUM FOR LYMPHOGRANULOMATOSIS. Fridlyand, I. B.; Kubareva, M. M.; Filkova, E. M. (Inst. of Roentgenology, Moscow). Med. Radiol., 12: 85-7(Jan. 1967). (In Russian).

Effects of radiotherapy on the amino acids content of erythrocytes and on distribution of amino acids between the erythrocytes and plasma were studied using 28 male and female patients suffering from lymphogranulomatosis. The results showed that following an effective treatment the content of amino acids in the erythrocytes of patients responding to the treatment was close to normal, while in patients not responding to the radiotherapy it deviated considerably from the normal. (R.V.J.)

39497 MEGAKARYOCYTOPOIESIS AND THROMBOCYTOPOIESIS IN PATIENTS WITH DIFFUSE TOXIC GOITER DURING RADIOIODINE TREATMENT. Piksanov, O. N.; Bykhovskaya, A. M. Med. Radiol., 12: 82-5(Jan. 1967). (In Russian).

Effects of therapeutic treatment with ^{131}I on cytopoiesis were studied in 84 patients suffering from toxic goiter. Experiments showed that the therapeutic treatment of the goiter with small quantities of ^{131}I produced significant remote effects on the thrombocytes and megakaryocytes, causing alterations in the marrow and peripheral blood. The remote effects lasted for 1 to 2 months or more; within 200 to 300 days after introduction of ^{131}I the alterations in the thrombocytogram and megakaryocytogram were negligible. Tabulated data are given on the sequence of effects of ^{131}I isotope on the thrombocytes and megakaryocytes in patients with diffusing toxic goiter. (R.V.J.)

39498 HEMATOPOIETIC REPOPULATION AFTER INTESTINAL SHIELDING FROM X-IRRADIATION. Murphy, M. J.; Porteous, D. D.; Gordon, A. S. (New York Univ.). Nature (London), 215: 722-3(Aug. 12, 1967).

Methods most commonly employed to produce repopulation after irradiation are (1) exogenous colonisation, or "grafting," by injection of healthy haematopoietic tissue, (2) endogenous colonisation accomplished by the shielding of haematopoietic tissue. It was concluded by some workers that exocolonisation, involving considerable cellular handling, gives a different recovery pattern from that observed with endocolonisation. Other workers found that whereas grafted lymph node and foetal thymus suspensions and thoracic duct lymphocytes failed to elicit postirradiation recovery in mice; when the exteriorised gut was shielded from 1,025R, 26.6% survived for 30 days, and haematopoietic recovery was nearly complete in 8 days. The experiments described were performed in an attempt to resolve this apparent discrepancy; they consisted of examining the haematopoietic potential of the lead shielded intestine in the irradiated mouse. Each irradiated animal received 700 R at 60 R/min., and the shielding was sufficient to attenuate the dose to less than 0.5%. Iron-59 was used as tracer. Eight days after irradiation all animals were bled and their peripheral erythrocyte and whole spleen activities were determined. Animals with intestines shielded showed higher incorporation of ^{59}Fe into peripheral red blood cells and spleens than unshielded animals. The most likely origins of the repopulating cells in the shielded region are the mesenteric lymph nodes and Peyer's patches, although the existence of migratable stem cells in the non-lymphoid tissue or blood of the protected area cannot be precluded. Failure of these cells to show colonising capacity on transplantation may be the result of sensitivity to handling, whereas similar cells in vivo may retain this property. The findings of increased erythropoiesis and colonisation in the shielded animals probably resulted from the seeding of such cells into the spleen and bone marrow. (UK)

39499 AGE DEPENDENCE OF RADIATION SENSITIVITY OF HAEMOPOIETIC CELLS IN THE MOUSE. Proukakis, C.; Lindop, P. J. (St. Bartholomew's Hospital, London). Nature (London), 215: 655-6(Aug. 5, 1967).

During a long-term study of the effect of age at exposure on the incidence of leukaemia after whole-body irradiation the age dependence of cell killing of the hematopoietic system of the mouse was investigated. Two methods for assaying hematopoietic stem cell survival were employed, involving the endogenous and the exogenous spleen colonies. The mice were irradiated with the electron beam of a 15 MeV linear accelerator at a dose rate of approximately 400 rads/sec. The number of mice surviving 10 days after irradiation was 69% for 6 week old animals and 67% for 30 week old animals when the exogenous (transplantation) technique was used; and 74% and 86%, respectively, with the endogenous technique. The combined results for both techniques are shown in graphical form, as cell survival curves, each colony deriving from one single cell. For the 6-week-old group the D_0 values were 93 and 95 rads for the exogenous and endogenous techniques, respectively, and the corresponding values for the 30-week-old group were 122 and 129 rads. The weighted average D_0 values were 93.9 ± 4.6 rads and 126.2 ± 6.0 rads for the 6-week and 30-week groups, respectively. This difference between the D_0 values for the two ages is statistically highly significant and agrees well with the previously reported age dependence of radiation sensitivity at these ages using the $LD_{50/30}$ days as the end point. No dependence on age of the radiation sensitivity of these cells has previously been reported, except for colony forming cells deriving from foetal liver. Extrapolation numbers of 2.4 ± 0.64 and 1.42 ± 0.33 are obtained for the 6 week and 30 week groups. If this difference is significant it might be explained as the result of the accumulation of "faults" with age, necessitating fewer events to inactivate the cells in older mice. (UK)

39500 CONCENTRATION OF IMMUNOGLOBULINS IN LETHALLY X-IRRADIATED MICE. Micklem, H. S. (Dept. of Zoology, Edinburgh); Bazin, H. Nature (London), 205: 742-4 (Aug. 12, 1967).

Results hitherto published in this field have relied on electrophoresis and immunoelectrophoresis techniques. The former, although it can yield some quantitative information, does not adequately distinguish between different classes of immunoglobulin, and the latter, while offering excellent resolution of immunoglobulin classes, is only in the roughest way quantitative. The studies indicated that a profound drop occurs in the concentration of gamma globulins within a few days of lethal irradiation. The availability of unispecific antisera to each of the four mouse immunoglobulins – IgA, IgM, IgG1, and IgG2a – and the development of the technique of single radial diffusion in agar, whereby such antisera can be used to yield quantitative measurements of their corresponding antigen, have made it possible to obtain more precise information concerning the effects of radiation on the concentration of immunoglobulins. Experimental studies with mice receiving 1,000 and 800 rads X-radiation are described, the irradiation being administered ventro-dorsally to the whole body. Serum samples were taken and titrated in single radial diffusion

against each of the four unispecific anti-Ig sera. There were no significant differences between the two irradiated groups with regard to any of the four immunoglobulins. Concentrations of each of the four immunoglobulins in the serum are shown graphically. In each case there was a progressive significant fall in concentration from that before irradiation, and this was most pronounced with IgA. The results did not support the view that the concentration of immunoglobulins in the serum are profoundly reduced after lethal irradiation doses. There appeared to be a particularly marked effect on IgA, but even this protein by no means entirely disappeared. The difference between the present and previous conclusions is probably in large measure attributable to the greater sensitivity of the technique of single radial diffusion. Other factors, such as age, strain, immunological status, infection, etc. may also have exerted an influence. (UK)

39501 PREVENTION OF RADIOLEUKEMIA BY LYMPH NODE SHIELDING. Ilbery, P. L. T. (Univ. of Sydney). Nature (London), 215: 656-7(Aug. 5, 1967).

In mice irradiated to produce a high incidence of leukaemia of the thymic lymphoma type it has been shown that the administration of foetal haemopoietic tissue leads to the presence of dividing cells, having the chromosome characteristics of the donor, in the target organs of the hosts, and a significant drop in the mortality from leukaemia. It has been suggested that the inhibition of radioleukaemia follows repopulation of haemopoietic tissues and thymus by unirradiated donor cells. The incidence of radioleukaemia which appears to have its origin within the thymus paradoxically unaltered by intravenous administration of lymph node material in dissociated form. Other cells intimately associated with the lymph node, but difficult to dissociate from its structure, may have been excluded in the preparation of such lymph node inocula. Because of this, and because feedback mechanisms may implicate the endothelial cells of the post-capillary vessels in lymph nodes, and perhaps littoral cells, the role of whole lymph node in situ in altering the pattern of leukaemia induction was studied. Four divided fractions of 200 rads γ radiation were given at intervals of 4 days. A single lymph node was shielded under a lead block in a proportion of the animals. Lymphoid tissue is among the most sensitive of the tissues to ionising radiation, but from these studies it seems clear that maintenance of even a small amount by shielding is a potent factor in hindering the onset of radioleukaemia. It appears that early restoration of some immunologically competent cells following haemopoietic grafting is likely to be the important factor, and may be the mechanism lowering the incidence of radioleukaemia by contending with rogue cells or preventing activation of latent virus. (UK)

39502 MALE SPHAEROPTHALMINE MUTILLID WASPS OF THE NEVADA TEST SITE. Ferguson, William E. (San Jose State Coll., Calif.). Contract AT(11-1)-1326. Brigham Young Univ. Sci. Bull., Biol. Ser., 8: No. 4, 1-26(June 1967). (COO-1326-4).

An ecological and taxonomical study of the sphaeropthalmine Mutillidae of the Nevada Proving Grounds Area was made. Important contributions to the data on distribution and taxonomy of the nocturnal Mutillidae are also included; new species of male mutillids are described. It was shown that former ground zeros of nuclear detonations were reoccupied by the mutillids within a few years after a blast or series of blasts. A careful search for anatomical changes among the Mutillidae collected at the test site revealed that the nuclear testing did not produce any genetic abnormalities. (B.H.S.)

39503 CERTAIN INDICES OF THE BIOELECTRIC CEREBRAL ACTIVITY IN PERSONS SUBJECTED TO THE ACTION OF IONIZING RADIATION DURING WORK. Stepanov, A. I. Gig. Sanit., No. 4, 47-9(Apr. 1967). (In Russian).

In various functional loads and dosed hyperventilation (60l of air during 3 min) electroencephalograms were made for 154 persons, subjected during work to the action of ionizing radiation in a dose of 2 R a year. The electroencephalograms of these persons presented no shifts from the normal level and no differences from those of the control group. The average values of α-rythm amplitudes were the same both before and after hyperventilation. (auth)

39504 POSSIBILITY OF PROLONGING THE TERMS OF TAKE OF SKIN HOMOTRANSPLANTS BY THE METHOD OF LOCAL X-RAY IRRADIATION. Kirpatovskii, I. D.; Lebedeva, E. D.; Shuvaev, V. V.; Galperin, Yu. M.; Morozov, A. I. Med. Radiol., 11: No. 10, 64-5(Oct. 1966). (In Russian).

Experiments were carried out with 62 white rats subjected to cross homotransplantation in the loin and exposed to various doses of irradiation in the region of the skin transplantation and regional lymph nodes. The results showed that local irradiation of the homografts region and regional lymph nodes prolonged the time of take of skin homografts. The radiation doses, the time of irradiation, and the time intervals between exposures played an important role in the reaction to local irradiation. (R.V.J.)

39505 CHANGES IN THE ELECTROCARDIOGRAM (ECG) OF VARIOUS ANIMALS (RABBITS, RATS, AND BIRDS) SUFFERING FROM ACUTE RADIATION SICKNESS OF VARYING DEGREES. Movsesyan, M. A.; Mailyan, E. S.; Melik-Mkrtchyan, L. N. Zh. Eksp. Klin. Med., 5: 17-22(May 1965). (In Russian).

Experiments on 25 rabbits, 20 rats, and 15 birds (roosters and hens) are described in which 15 rabbits, 10 rats, and the 15 birds were exposed to x radiation with a single dose (measured in air) of 800 R, and the rest of the animals to 1500 R. ECG studies were made immediately after irradiation, after 10 to 15, 25 to 30, and 55 to 60 min, after 24 hr, and then after 3, 6, 8, 10, and 25 days. In both groups of rats, no consistent changes in the ECG appeared. In the birds there were insignificant changes in the ECG, pointing to diffuse lesions in the heart muscle. It is possible that these changes were the result of hemorrhages in the heart muscle that accompany radiation sickness. Generally, the results in the birds were slight and inconsistent in comparison with results obtained in rabbits. Both groups of rabbits had consistent changes in the ECG. The 800-R exposure provoked acute radiation sickness, of light or medium severity. Of this group four died, and no radiation shock was observed in the group. For the most part, nutrition of the heart muscle was affected, and consequently the muscle's contractile function. Rabbits of the 1500-R group were affected by severe radiation sickness resulting in death. On the first day, four rabbits died, and on the fifth and eighth days three more died, all in radiation shock; the remaining three, although no shock occurred, had a definite change in the ECG which again pointed to damage to the heart muscle and its contractile function. Conductivity was also affected. In the most severe shock cases, the ECG tracing was characteristic of terminal heart failure. (BBB)

39506 ULTRASTRUCTURAL STUDIES OF SPLEEN AFTER WHOLE-BODY IRRADIATION OF MICE. Jordan, S. W. (Atomic Bomb Casualty Commission, Hiroshima). Exp. Mol. Pathol., 6: 156-71(Apr. 1967). (TID-22537).

Acute effects of 800 R, whole-body, x irradiation upon lymphoid tissue of the mouse spleen were studied. Mature lymphocytes showed early cytonecrosis, characterized by marked cellular shrinkage without fragmentation, and usually were phagocytized whole by reticular macrophages, subsequently fragmented, and digested. Immature lymphocytes showed chromatin clumping, in addition to cytonecrotic changes like those in mature lymphocytes but appeared less sensitive to radiation than mature lymphocytes. There was mild dilation of endoplasmic reticulum cisterns in plasma cells, and reticular macrophages, megakaryocytes, and fibroblasts appeared to be little effected by irradiation. Most of the lymphocytes became necrotic and were phagocytized in the first eight hrs. after irradiation. Necrosis of lymphocytes continued at a slower rate, suggesting that the diminution of splenic cellularity several days after irradiation resulted from loss of individual cells as well as retarded regenerative proliferation. (BBB)

39507 THE EFFECTS OF LASER IRRADIATION ON THE CENTRAL NERVOUS SYSTEM. I. PRELIMINARY STUDIES. Hayes, Jude R.; Fox, John L.; Stein, Marvin N. (Veterans Administration Hospital, Washington, D. C.). J. Neuropathol. Exp. Neurol., 26: 250-8(Apr. 1967).

Effects of focused ruby laser radiation on the brains of mice, rats, and guinea pigs, both with and without craniectomy, were studied. Removal of the intervening skull bone increased the amount of energy absorbed by the brain, but markedly decreased the mortality rate. At sufficient energies, one pulse train focused on the exposed intact skull fractured the skull and herniated the brain through suture lines. Respiration ceased immediately, and cardiac contractions stopped in 12 to 15 min. Coagulation, necrosis, and hemorrhage, surrounded by edema, were seen microscopically at the site of irradiation. Examination of the blood-brain barrier with a fluorescein tracer revealed injury at the impact point and along the basal structures of the brain and brain stem when the skull bone was not removed. This indicated caudal herniation of the temporal lobe and brain stem. Maximum damage occurred if the focal point of the beam was on the surface of the skull. Gas bubbles produced by laser irradiation contained oxygen, nitrogen, and lighter gases of an undetermined nature. (BBB)

39508 THE SURGICAL TREATMENT OF SKIN DAMAGED BY RADIATION. Vrabec, Radko (Charles Univ., Prague). Acta Chir. Plast., 9: 79(1967).

This report is based on a study of 461 patients with acute and chronic changes arising in the skin after x irradiation as a result of treatment or occupational exposure. The analysis of this material from all aspects brought to light some important findings. Many cases of malignant changes were noted after radioderma-

titis. Tumors developed most often after ulceration; a long period of latency was necessary for development of the malignant changes. The commonest tumor type was spinocellular carcinoma. Conservative treatment of x-ray ulcers is advised only during preparation of the patient for surgery. Surgical treatment is absolutely indicated in radioinduced ulcers on account of the danger of malignancy. It is also essential for tumors arising from irradiation. Chronic radiodermatitis with necrosis, which shows a tendency to proliferative changes, especially with the formation of keratomas, is an absolute indication for operation because malignant degeneration always occurs eventually. A relative indication for surgery is provided by chronic radiodermatitis, with varying degrees of atrophy without evidence of proliferation, which constitutes a functional or cosmetic defect. These cases should be treated by the plastic surgeon who should also deal with the deformation and residual conditions after the treatment of the radiation damage. The basic principle in the surgery of all postirradiation skin changes is the radical removal of all damaged tissue and its replacement by skin grafts. (BBB)

39509 NOTES ON EFFECTS OF X-IRRADIATION ON THE FERTILITY OF THE MALE OF ORYZIAS LATIPES (TELEOSTEI, CYPRINODONTIDAE). Konno, Kenjiro; Egami, Nobuo (Tokyo Univ. of Fisheries. National Inst. of Radiological Sciences, Chiba, Japan). Annot. Zool. Jap., 39: 63-70(June 1966).

The breeding female of Oryzias latipes kept together with a normal male lays fertilized eggs almost every day. Following irradiation of the male fish with 2 kR of x rays, the percentage of fertilized eggs laid by the female decreased during a period ranging from 2 to 6 weeks. Temporary reduction in testicular weight occurred in males irradiated with 0.1 to 2 kR. Histological studies of testes revealed that varying numbers of spermatogonia and spermatocytes had been affected by x rays. Oocyte-like cells were frequently encountered in testes recovering from the damage 30 to 60 days after irradiation. Irradiation of males with 8 kR resulted in complete degeneration of testes. (auth)

39510 EXPERIMENTAL DICTIOCAULOSIS OF GUINEA PIGS WITH DICTYOCAULUS FILARIA (RUDOLPHI 1809). OBSERVATIONS ON THE VITALITY AND DEVELOPMENT OF THE 3rd STAGE LARVAE OF DICTYOCAULUS FILARIA IRRADIATED BY MEANS OF ^{60}Co AT VARIOUS LEVELS OF IONIZING RADIATION (AT 40,000 AND 50,000 R). Casarosa, Lisimaco (Univ., Pisa, Italy). Ann. Fac. Med. Vet., Univ. Pisa, 18: 45-53 (1965). (In Italian).

Attempts were made to develop a radioattenuated vaccine of Dictyocaulus, a helminth parasite of sheep. The larvae were irradiated at a dose rate of 100 R/min with ^{60}Co to doses of 40,000 and 50,000 R. Guinea pigs received 500 larvae orally and were submitted to macroscopic and histologic examination 3, 5, 7, 10, 25, and 38 days after infestation with normal or irradiated larvae. By the 10th day no worms were found in the lungs of animals given 40,000 R irradiated larvae and only an average of 0.33 worms per animal in the 50,000 R group, compared to 30 in the control group. By the 25th day no worms were present in the irradiated-larvae groups. At the 3rd, 5th, and 7th day after infestation the length of worms that were found in the lungs in the irradiated series were smaller than in the control series, indicating inhibition of growth by irradiation. Histopathologic examination showed less pulmonary injury from parasitism in the guinea pigs given irradiated larvae. (BBB)

39511 ACUTE X-RAY LETHALITY IN THE MOUSE: COMPARISON OF ULTRAHIGH DOSE RATE WITH MORE USUAL DOSE RATES. Caldwell, William L.; Sloan, David H. (Physics International Co., San Leandro, Calif.). Radiology, 89: 335-7 (Aug. 1967).

The effect of dose rate on acute x radiation lethality of mice was studied using 332 mice divided into two groups and exposed to either high dose-rate x irradiations or x rays from a 6 MVp linear accelerator delivered at 300 rads/min. The high dose-rate x rays were obtained from a 3 MeV pulser that delivered x rays at a rate of approximately 1.2×10^{12} rads/min. The dose per pulse was relatively constant (approximately 50 R/pulse measured at 1 m), and different target-animal distances (16 to 30 cm) were required to alter the dose for the irradiations. Animals were exposed to a single pulse, and the average duration of the pulses was 40 nanoseconds. The linear accelerator irradiations lasted from 2.5 to 5.8 min and were delivered at 100 cm target-animal distance. Radiation doses were determined from readings of four previously calibrated LiF dosimeters placed at the periphery of the irradiation field. The LD 50/30 for the two different doses were not significantly different, being 950 ± 72 rads for the ultra-high dose-rate from the pulser and 915 ± 60 rads for the lower dose-rate from the linear accelerator. Possible implications of the findings in high dose-rate therapy are discussed briefly. (C.H.)

39512 BIOLOGICAL SENSITIVITY TO RADIOFREQUENCY AND MICROWAVE ENERGY. Bach, Sven A. (Army Medical Research Lab., Fort Knox, Ky.). Fed. Proc. Transl., 24: Suppl. 14, S22-S6(Jan.-Feb. 1965).

Three possible mechanisms of interaction of radiofrequency and microwave energy with the biologic target were considered. First, thermal effects are examined. Regardless of mechanism, factors influencing the absorption of energy are the radiation pattern, frequency and polarization of the radiation, and the size, shape, orientation, electrical characteristics, and anatomic arrangement of the target. This makes even a thermal interaction a complicated problem for assessment. A second possible mechanism is demodulation of pulsed signals within various organs and tissue because of the electrical nonlinearity of certain regions of the body, particularly the brain and spinal cord. A third mechanism yet to be proven is termed molecular. Certain bacterial exotoxins have been attenuated by r-f energy. The endotoxin of Salmonella typhosa can be enhanced in its physiological effect by exposure to r-f energy, and human γ-globulins can be altered in their electrophoretic and antigenic properties. The enzyme α-amylase can be deactivated to a great degree by frequencies around 12 Mcps. (BBB)

39513 SOME BLOOD INDEXES AFTER IONIZING IRRADIATION OF ANIMALS WITH REDUCED THYROID FUNCTION. Kil'chevskaya, M. A.; Rubinshtein, M. Ya.; Gurvich, M. G. Zdravookhr. Beloruss., No. 6, 8-9(1965). (In Russian).

Irradiation of hypothyroid rats with a dose of 600 R produced no significant change in the total serum iodine but increased the content of free iodine and caused a reduction in the esterification coefficient. Neither iodine content nor the ratio of serum fractions was affected by irradiation in healthy rats. Hemoglobin content and number of erythrocytes in blood also remained unchanged. However, hemoglobin content was increased while the number of erythrocytes was decreased in irradiated hypothyroid rats as compared to unirradiated hypothyroid animals. (C.H.)

39514 THE VARIATION OF PERIPHERAL BLOOD COUNTS IN RATS REPEATEDLY EXPOSED ON RECOVERY TO TOTAL BODY LOW LEVEL RADIATION (50 r). Hochmann, A. (Rothschild Hadassah Univ. Hospital, Jerusalem); Feige, Y.; Neharin, A. Radiol. Clin. Biol., 36: 15-23(1967).

The effects of repeated low sublethal total-body exposures on the blood picture of 24 rats was studied for a period of 20 months. A total of 10 x ray exposures, 50 R each, were administered, each dose being given after apparent full recovery of the peripheral white cell count. A cumulative effect of radiation over the first 4 exposures, as expressed in the progressively greater drop, up to 40%, in the leukocyte count 24 hr after irradiation, and a gradual prolongation of the recovery period up to 80 days was observed. Stabilization of the radiological effect over the last 4 exposures was expressed in a drop of about 27% and a 60-day recovery period. Though the stabilization observed might be interpreted as a gradual development of radioresistance induced by the repeated irradiations, natural causes such as age might contribute to the production of a two phase phenomenon. (auth)

39515 SINGLE DOSE ERYTHEMAS OF SKIN IN HYPERBARIC RADIATION THERAPY. Parker, R. G.; Wootton, P. (Univ. of Washington, Seattle). Radiol. Clin. Biol., 36: 24-6(1967).

In 7 adult patients, there was no evidence that oxygenation under 30 p.s.i.g. alters the 24- or 48-hour single dose erythema of the skin of the thigh produced by x ray of HVL 2.0 mm Cu. Instantaneous erythema was noted in two patients. Such testing will be extended to include several qualities of radiation and various fractionated patterns of application. (auth)

39516 RADIATION-INDUCED HEART DISEASE. A STUDY OF TWENTY-FIVE PATIENTS. Stewart, J. Robert; Cohn, Keith E.; Fajardo, Luis F.; Hancock, E. William; Kaplan, Henry S. (Stanford Univ., Palo Alto, Calif.). Radiology, 89: 302-10(Aug. 1967).

Twenty-five patients in whom significant heart disease developed after fractionated radiation to the chest for a variety of malignant neoplasms have been described, and the heart disease classified according to the clinical and pathological features observed. Acute pericarditis, often with pericardial effusion and tamponade, chronic pericardial effusion, and chronic constrictive pericarditis sometimes associated with myocardial and/or endocardial fibrosis or fibroelastosis were most commonly seen. Five of these cases were fatal. An additional patient died at the age of fifteen of myocardial infarction sixteen months after irradiation. In the majority of patients detectable heart disease developed after a delay of several months. Most had received at least 4,000 rads to a sizable portion of the heart, and the more severe cases occurred among patients who had received the highest radiation doses to the heart (up to 8,950 rads). The importance of recognizing this complication of radiation therapy is stressed in order that proper treat-

ment may be instituted. Radiation-induced heart disease, particularly pericarditis, is apparently more frequent and important than is commonly appreciated and should be considered a significant risk of high-dose radiation therapy to the thorax. (auth)

39517 RELATIONSHIPS OF X IRRADIATION TO THE ENHANCEMENT OF CANDIDA ALBICANS INFECTIONS. Gordee, Robert S.; Simpson, Patrick J. (Eli Lilly and Co., Indianapolis). J. Bacteriol., 94: 6-12(July 1967).

Preirradiation significantly reduced the number of Candida albicans cells required for the LD_{50} of experimentally infected mice. The start and extent of recovery of total leukocytes of preirradiated infected mice were proportional to the dose of x rays administered. During 10 days postinfection, heterophils of infected mice preirradiated with 400 R recovered to levels above unirradiated, uninfected controls but did not exceed those of unirradiated, infected animals. On the other hand, the more radiosensitive lymphocytes were depressed greatly, and a limited recovery below normal values was obtained. The lymph to heterophil ratio of uninfected mice irradiated with 400 R recovered to normal values by 11 days postirradiation. However, decreases in the ratio of unirradiated or x-irradiated infected mice showed little recovery. During 6 to 10 days postinfection, a reduction in microhematocrit values after a dose of 400 R alone was not observed when a C. albicans infection was superimposed on x-irradiated mice. This difference was not due to changes in the red blood cell volume which was decreased by 400 R with or without infection, but was attributed to a greater decrease in plasma volume caused by a combination of x irradiation and infection. Reticulocyte counts indicated that recovery from the significant decrease in erythrocyte production caused by 400 R was retarded by a progressive infection. Elevated total serum protein of unirradiated mice at 6 days after infection was attributed to increases in α- and β-globulins. A dose of 400 R limited but did not prevent an increase in α- and β-globulins upon subsequent infection. Candida species infection or 400 R or both did not greatly affect the concentration of γ-globulins. The albumin to globulin ratio of irradiated, infected mice was intermediate between those ratios found after x irradiation or infection. (auth)

39518 ROLE OF THE PHAGOCYTE IN HOST-PARASITE INTERACTIONS. VIII. EFFECT OF WHOLE-BODY X IRRADIATION ON NICOTINAMIDES, LYSOSOMAL ENZYMES, AND BACTERICIDAL ACTIVITIES OF LEUKOCYTES DURING PHAGOCYTOSIS. Selvaraj, R. J.; Sbarra, A. J. (St. Margaret's Hospital, Boston. Tufts Univ., Boston). J. Bacteriol., 94: 149-56 (July 1967). (NYO-3240-16).

By studying the effects of whole-body x irradiation on phagocytosis, a correlation between the metabolic and bactericidal activities of leukocytes following x irradiation was demonstrated. The total nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP) content of polymorphonuclear neutrolphils (PMN) isolated from irradiated guinea pigs increased significantly when compared to nonirradiated controls. The ratio of unreduced to reduced (NAD) generally increased in PMN isolated from irradiated animals. This occurred with both resting and phagocytizing cells. The ratio of unreduced to reduced NADP of resting PMN isolated from irradiated animals had a tendency to increase. However, in phagocytizing cells a significant decrease in the ratio was noted. The total acid and alkaline phosphatase and β-glucuronidase increased up to about 10 days postirradiation. These lysosomal enzymes returned to approximately normal by the 17th day postirradiation. All three lysosomal enzymes (acid and alkaline phosphatases and β-glucuronidase) were released from the granules at a significantly faster rate during phagocytosis after irradiation. The bactericidal activities of PMN isolated from irradiated animals gradually decreased, and in some cases increased growth of the organisms was observed. The uptake or association of bacteria with PMN isolated from irradiated animals varied with the postirradiation time. Generally, a correlation with bactericidal activities could be made. The data indicate that the bactericidal system in phagocytes consists of at least two agents. H_2O_2 and myeloperoxidase. (auth)

39519 EFFECTS OF HIGH-TEMPERATURE ON IRRADIATED MEDFLY PUPAE. Katiyar, Kamta P.; Ferrer, Francisco Turrialba, 17: 31-4(Jan. Mar. 1967). (In Spanish).

Irradiated (10 kR) and normal pupae of Ceratitis capitata Wied. were incubated for 2, 4, 6, and 8 hours at temperatures of 25, 30, 40, and 45°C, and 60 to 85 percent relative humidity. Adult emergence was normal up to 40°C. Exposure to 45°C for two hours or longer was lethal to x-irradiated as well as normal pupae. A heat treatment of 40°C for 8 hours immediately after irradiation had no latent adverse effect on the longevity of the adults. Irradiated females survived longer than normal females. (auth)

39520 EXPERIMENTAL STUDIES ON THE CHARACTERISTICS OF VARIOUS GENES IN THE SILKWORM. (NO. I). Tanaka, Yoshimaro; Goto, Fumio Sanshi Kagaku Kenkyusho Iho, No. 14, 20-5(Mar. 1966). (In Japanese).

In the strain in which the hereditary effect has been diminished after a series of close relative crossings and selections, it is very important to know whether it is possible to increase the selectivity by increasing the hereditary variations due to a certain mutation-inducing agent. However, most of the useful characters are affected adversely by application of radiations, and in addition, the nonhereditary variations that occur tend to confuse the interpretation of the results. In the present study, therefore, by way of the basic research for the future breeding of silkworms two kinds of readily discernible maculae not connected with the mutagenic effect of radiation were used. Silkworm eggs were x-irradiated at doses of 500 to 1000 R one hour after laying, and the maculae distributions that subsequently occurred in the third and fourth generations were compared with those of the control group. No effect was observed in the range of experiments performed; results agreed with those obtained for chickens. (NSA of Japan)

39521 ULTRASTRUCTURAL MODIFICATION IN IRRADIATED HUMAN SMALL BOWEL MUCOSA. De Dominicis, R.; Grechi, G. (Univ., Florence). Med. Nucl. Radiobiol. Lat., 9: 435-59(1966). (In Italian).

Ultrastructural alterations of human small bowel (duodenum and first jejunal loop) that occurred during x-ray therapy of the abdomen were studied; doses varied from 200 to 3000 rad. In addition to modifications of the epithelial cells (alterations of the microvilli, increased diastasis between contiguous cells), modifications were observed in stroma elements and particularly in endothelial capillaries; a distinct increase in permeability and accentuation of the ultrapinocytosis phenomena were observed. (auth)

39522 INFLUENCE OF IONIZING RADIATION ON THE MORPHOGENESIS OF SKIN STRUCTURES IN CULTURES IN ORGANISMS ACCORDING TO LAZARENKO. Khoystova, Z. S.; Rakitina, O. N. (Orenburg Medical Inst., USSR). Radiobiologiya, 6: 574-7(1966). (In Russian).

The method of implantation according to Lazarenko was used to determine the regenerative capacity of implanted skin epithelium in the skin of animals that were injured by ionizing radiation. In one series of experiments, the skin of a healthy rabbit donor was implanted into recipients that were irradiated with single whole-body doses of 300, 500, 700, and 900 R. In other series, healthy recipients were implanted with skin from donors that were whole-body or locally irradiated at a dose of 500 R. Whole-body irradiation of the recipient was found to reduce the ability of regeneration of implanted skin tissues from a healthy donor. The decrease in the regenerative properties of the skin tissues of the donor was strictly correlated with the degree of radiation injury to the recipient organism. In the case of local or whole-body irradiation of the donor organism at a lethal dose, the skin tissues remained viable. When implanted into the organism of a healthy recipient, they manifested their own histio- and organoblastic properties. (JPRS)

39523 ENDOCRINE ACTIVITY AND STRUCTURE OF THE MURINE OVARY FOLLOWING IRRADIATION STERILIZATION. Hunter, Jerry Don. College Station, Tex., Texas A and M Univ., 1966. 107p.

Thesis.

Female albino mice were exposed to 350 R of ^{60}Co whole-body γ-radiation at 50 R per day at four separate periods of development which included the final week of gestation and the first, second and third weeks of post-partum (p.p.) maturation. These were injected with human chorionic gonadotrophin (HCG) at 21 days of age and ^{32}P at 23 days. The animals were sacrificed at 24 days of age and uterine weights and ovarian uptake of ^{32}P were determined as indexes of HCG response. None of the irradiated females had a significant decline in HCG response at this time. However, mice exposed during the first week p.p. showed a significant decline in HCG response using both uterine weight and ^{32}P uptake as criteria at 34 days of age. Mice irradiated during the third week p.p. likewise showed a significant decline in HCG response two weeks later or at 49 days of age. HCG response remained very significantly lower than controls at all times studied from 34 days to 150 days of age. The time of initial decline in HCG response was noted to coincide with the onset of total destruction of ovarian follicles. As long as any active follicles survived, HCG response was approximately normal. In addition to decline in HCG response and destruction of follicles, the estrous cycles of these irradiated females showed marked irregularity or usually total interruption. These results were concluded to infer that the ovarian follicles may be essential to normal estrogen secretion induced by HCG as well as required for control of regular estrous cycles. Both irradiated and normal females with and without HCG treat-

ment were injected with tritiated thymidine after which thymidine incorporation was noted by use of autoradiography. Thymidine incorporation (indicating DNA synthesis) by the interstitial cells of the sterile ovary was noted in only about 2% of all cells with no effect by HCG. Autoradiograph cell counts of both HCG treated and nontreated normal ovaries showed that about one-third of the follicular cells were labeled. HCG promoted no further apparent increase in labelling of the follicular cells. The interstitial cells of the HCG treated normal ovaries had about 10% of their total number labeled in contrast to only 1% labeled in non-HCG treated. These data were interpreted to support the hypothesis that the secondary interstitial cells of the ovary originate from follicular granulosa and theca cells perhaps in part by atresia and that this process is accelerated by HCG. The uteri of normal HCG treated females showed that numerous cells of the lamina propria had incorporated thymidine. In contrast, sterile HCG treated mice had little thymidine incorporation by the endometrium when compared with controls. This indicated a higher estrogen secretion in the normal mouse that was able to augment uterine DNA synthesis. Several immature females were irradiated at 20 R per day during the first fourteen days of post-partum growth. These animals also showed a decline in HCG response after 34 days of age and interruption of estrous cycles. (Disser. Abstr.)

Radiation Effects on Plants

Refer also to abstracts 39372, 39383, 39384, 39387, and 39485.

39524 (NP-16897) REPORT ON YEAST STRAINS PRESENT IN THE DIFFERENT FRUIT JUICES AND THE PROBLEM OF THEIR RESISTANCE TO IONISING RADIATIONS. Dupuy, P.; Mouton, R. (Institut National de la Recherche Agronomique, Versailles (France)). May 1965. 9p.

Yeasts were found to be the most radiation-resistant microorganisms contaminating fruit juices. In order to develop radiation processing methods for fruit juices, a program to determine radiation resistance of the most resistant species of yeasts is proposed. Among the following genera, several species are suggested for investigation: Candida, Cryptococcus, Kloeckera, Rhodotorula, Torulopsis, and Trigonopsis. (W.E.B.)

39525 (ORO-2066-11) ECOLOGICAL SIGNIFICANCE OF NEUTRON AND GAMMA RADIATION ON DORMANT AND PHYSIOLOGICALLY ACTIVE SEED AND SEEDLINGS OF TREE SPECIES NATIVE TO THE EASTERN DECIDUOUS FOREST. Progress Report. Heaslip, Margaret B. (Morehead State Univ., Ky.). [June 1967]. Contract AT(40-1)-2066. 38p. Dep. CFSTI.

Progress is reported on studies on the ecological significance of the exposure of seeds and seedlings of deciduous trees to various doses of fast neutrons and γ radiation. Data are reported from a study on the effects of various doses of fast neutrons followed by various doses of γ radiation on germination and survival of dormant or physiologically active seeds of ash, sweet gum, sycamore, walnut, and white oak. The effects of a number of variables, such as seed water content, rate of metabolism, age of seed, nuclear volume, physiological state, and post-irradiation storage time were studied. Species differences in the trees and in rate of seed germination are discussed. Preliminary observations indicate that the effects of fast neutrons and γ radiation on seed germination and survival are not additive. (C.H.)

39526 ON THE EFFECTS OF PRE-ILLUMINATION ON THE DEVELOPMENT OF PLASTIDS IN PRIMARY LEAVES OF γ-IRRADIATED ETIOLATED BEAN SEEDLINGS. Wrischer, Mercedes; Devide, Zvonimir (Inst. Rudjer Boskovic, Zagreb). Planta, 73: 319-23(1967). (In German).

Electron microscopic examination of plastid development of γ irradiated, etiolated plants has shown that grana development and greening of the leaves under the action of light is inhibited weakly by 10 KR doses, and completely by 200 KR doses. Etiolated seedlings of Phaeseolus vulgaris, before and after irradiation with 10, 25, and 50 KR in the dark, were exposed to 4000 Lux of white light for 1, 10, and 30 min. It was found that short preillumination considerably reduced the delay of grana development in the plastids caused by γ irradiation. Since in nonirradiated, etiolated material grana formation was stimulated by an equal preillumination, it was concluded that the observed phenomenon was not a consequence of protection or restoration processes, but of a photomorphogenic effect that is independent of γ irradiation. (BBB)

39527 EFFECT OF ULTRAVIOLET IRRADIATION ON BACTERIOPHAGE LAMBDA IMMUNITY. Tomizawa, Jun-ichi; Ogawa, Tomoko (National Inst. of Health of Japan, Tokyo). J. Mol. Biol., 23: 247-63(1967).

Nonlysogenic cells segregated from bacteria (Escherichia coli K12) carrying λb2 phage remain immune for four generations. Using these segregants, the effect of uv irradiation on immunity of cells that do not carry a prophage was studied. When immune, nonlysogenic cells were uv irradiated and then infected with λc1, uv-induced sensitivity depended on the amount and characteristics of immunity substance remaining in the segregants. When the cells were infected with a phage conferring immunity, the sensitivity depended on the immunity characteristics of the secondarily infecting phage also. The immunity contributed by $c1^+$, ind^s, and ind^- genes of λb2 was sensitive to uv irradiation. The ind^s immunity was more sensitive and the ind^- immunity less sensitive than wild-type immunity. When immune, nonlysogenic cells were uv irradiated and incubated in broth, immunity was abolished. The ind^s immunity was abolished faster and the ind^- immunity slower than wild-type immunity. Thus, immunity of immune nonlysogenic cells was not abolished immediately by uv irradiation but gradually on incubation after irradiation. Mechanisms of uv induction and the roles of proteins, immunity substance, and inducing protein, are discussed. (BBB)

39528 ABORTIVE LYSOGENIZATION OF BACTERIOPHAGE LAMBDA b2 AND RESIDUAL IMMUNITY OF NON-LYSOGENIC SEGREGANTS. Ogawa, Tomoko; Tomizawa, Jun-ichi (National Inst. of Health of Japan, Tokyo). J. Mol. Biol., 23: 225-45(1967).

The uv induction of sensitivity of Escherichia coli to phage lambda mutants was studied. When E. coli infected with phage λb2 at a high multiplicity were incubated, the phage was transmitted unilinearly to the descendants, and nonlysogenic cells were segregated. The nonlysogenic cells were immune for about four generations after segregation. The persistence of immunity was due to immunity substance produced by the $c1^+$ gene of abortive prophage before segregation, and not to the presence of a fragment of the phage genome harboring the $c1^+$ gene of λb2 or by the presence of the messenger RNA transcribed from that gene. The duration of immunity was the same for segregants from cells abortively lysogenic for $\lambda b2c1^+$, $\lambda b2ind^s$, or $\lambda b2ind^-$. Thus the difference in uv induced sensitivity of the cells carrying various c1 mutants was not caused by the difference in amount of immunity substance. The nature and functions of immunity substance for lysogenization are discussed. (BBB)

39529 RADIATION-INDUCED LOSS OF REPRODUCTIVE INTEGRITY IN THE STAMEN HAIRS OF TRADESCANTIA BLOSSFELDIANA MILDBR., A TWELVE-PLOID SPECIES. Ichikawa, S.; Sparrow, A. H. (Brookhaven National Lab., Upton, N. Y.). Radiat. Bot., 7: 333-45(1967). (BNL-11227).

Inflorescences of Tradescantia blossfeldiana ($2n = 72$), a 12-ploid species, were exposed to 0.5 to 4kR of ^{137}Cs γ-rays for 16 hr. Stamen hairs from the irradiated inflorescences and from the control plants were observed daily for 27 days after irradiation. Decrease in cell number per hair and various morphological abnormalities at the hair apex were observed after certain post-irradiation periods. Both effects were dose-dependent. They could be seen the first 10 to 12 days after irradiation, with maximum effects at 13 to 20 days. The higher the exposure, the later the effects were observed to occur. The total number of new hair cells produced fell with increasing exposures. In the lower and medium exposure range, many hairs were only a few cells shorter than normal, and very few hairs were badly stunted. With increasing exposures the variability in hair length (cell number) increased, i.e. more and more short hairs were seen. In only a few cases, however, was this increased variability accompanied by a clear bimodal distribution of hair lengths. The relatively large number of intermediate length hairs was not expected, but it is concluded that they were the result largely of lengthened cell cycle times. Delayed loss of reproductive integrity, however, is also a possibility that cannot be ruled out. The frequency of stunted hairs that had lost most of their reproductive integrity (those with 15 cells or less) increased with increasing exposure. The survival curve for the terminal cells of the young stamen hairs was drawn, based on the stunted hair frequencies, with a resultant D_{37} of 1880 R. This value is compared with the D_{37} (270 R) for a diploid Tradescantia published earlier. The difference between the two values is best explained by the difference in the interphase chromosome volumes of the two materials, hence genetic redundancy appears to have little or no effect. The postirradiation growth (total increase in cell number) of the stamen hairs was estimated for each exposure. On a semi-log plot it showed an inverse linear relationship with increasing exposure. No shoulder was apparent. (auth) (UK)

39530 THE EFFECTS OF INHIBITORS OF PROTEIN SYNTHESIS ON THE DIFFERENTIATION OF PLASTIDS IN ETIOLATED BEAN SEEDLINGS. Wrischer, Mercedes (Inst. Rudjer Boskovic, Zagreb). Planta, 73: 324-7(1967).

In studying the effects of γ rays on differentiation of plastids, a

delay or inhibition of grana formation was observed. Since this radioinduced delay may be caused by the inhibition of protein synthesis, the effect of some inhibitors of protein synthesis on the development of chloroplasts was investigated. Chloramphenicol (0.1 to 0.5%), 2-thiouracil (0.01 to 0.2%), D,L-5-methyltryptophan (10^{-4} to 10^{-2}M), and D,L-ethionine (10^{-2} to 5×10^{-2}M) did not influence the breakdown of the crystal-lattice-like structure of the prolamellar bodies in the plastids when etiolated plants were exposed to light. The formation of grana and the greening of leaves were considerably inhibited, depending on the concentration of the inhibitor used. (BBB)

39531 EFFECTS OF IRRADIATION ON AMINO ACIDS BIOSYNTHESIS IN BARLEY. Picciurro, G.; Cervigni, T. (CNEN, Casaccia, Italy). G. Bot. Ital., 72: 313-18(1965). (In Italian). (RT/BIO-(66)15).

The effect of radiations on the biosynthesis of amino acids in barley was studied. Seeds were irradiated with x rays of 7.5 and seedlings with 7.5, 15, and 30 kR. After 6 to 7 days of growth the control and irradiated seedlings, and the seedlings from control and irradiated seeds, were supplied with 10 to 100 μ Ci of $^{14}Co_2$ in a closed chamber for 40 to 42 hours. The material was extracted with hot ethanol (85% to 80% and 40%). Total radioactivity and the radioactivity of the basic fraction, eluted with HCl from Dowex 50, X-8' (200 to 400 mesh, H^+) were measured. It was observed that radiations increase the radioactivity of the amino acid fraction, both in leaves and roots. A correlation between the decrease of fresh weight and increase of amino acids radioactivity was shown. A possible explanation might be visualized in terms of the inhibition of growth and protein synthesis by radiations. (auth)

39532 THE INFLUENCE OF SEED RIPENESS ON THE OUTPUT OF CHROMOSOMAL ABERRATIONS IN γ-RAYED BARLEY. Nuzhdin, N. I.; Pastushenko-Strelets, N. A. (Inst. of Biological Physics, Moscow). Dokl. Akad. Nauk SSSR, 172: 966-8(1967). (In Russian).

The radiosensitivity of seeds depends on the stage of ripening at the moment of irradiation. The problem was investigated by determining the numerical chromosome aberrations in two types of summer barley (Jubilee and Kharkov 306) irradiated at three stages of ripening cycle by a ^{60}Co source. The number of cells with dicentric bridges and acentric fragments were counted during the late anaphase and early telophase. It was found that with increasing ripening, the number of cells exhibiting chromosome aberrations decreased rapidly, confirming that the state of ripening at the time of the exposure is an important factor. The large number of cells with chromosome aberrations in the samples irradiated at an early stage of ripening resulted in a marked decrease of germination. The change in the radiosensitivity was attributed to differences in the biochemical composition of the endosperm and the relatively high activity of oxidative-reductive ferments in unripe seeds. (TTT)

Radiation Effects on Microorganisms

Refer also to abstracts 39339, 39445, 39485, 39512, and 39524.

39533 (COO-1183-20) GROWTH CHARACTERISTICS OF TYPE E CLOSTRIDIUM BOTULINUM IN THE TEMPERATURE RANGE 34 TO 50 F. Annual Report, January 15, 1966-April 30, 1967. (Continental Can Co., Inc., Chicago, Ill. Metal Div. Research and Development). Contract AT(11-1)-1183. 112p. Dep. CFSTI.

Progress is reported on investigations concerned with the γ-radiosensitivity of type E Clostridium botulinum spores from γ-irradiated survivors, γ-radiosensitivity of type E spores in marine homogenates and phosphate buffer in relation to incubation temperature, outgrowth of type E spore inocula in selected marine substrates, preparation and standardization of spore suspensions, toxin assay procedures, and toxin development in fresh marine products. (B.H.S.)

39534 (TID-23855) MUTAGENESIS OF ENTEROVIRUSES BY GAMMA RAYS. Technical Progress Report, September 1, 1966-August 31, 1967. Cliver, Dean O. (Wisconsin Univ., Madison. Food Research Inst.). Contract AT(11-1)-1645. 10p. Dep. CFSTI.

Progress is reported on a study to determine changes in virulence, host ranges, and antigenic specificity of enteroviruses after irradiation with 250,000 to 500,000 rads of γ radiation from a ^{60}Co source. The work has application to food radiopasteurization. During the report period, test procedures were standardized, and baseline properties of the unirradiated model virus strains were established. Model viruses to be used include poliovirus type 1, strain CHAT; Coxsackie virus type A-9, strain P.B.; Coxsackie virus type B-2; and ECHO virus type 6, strain D'Amori. (W.E.B.)

39535 INTERACTION BETWEEN ULTRAVIOLET LIGHT AND γ-RADIATION DAMAGE IN THE INDUCTION OF MUTANTS OF ESCHERICHIA COLI: THE EFFECT OF SOME MODIFYING TREATMENTS. Bridges, B. A. (Medical Research Council, Harwell, Eng.); Munson, R. J.; Arlett, C. F.; Davies, D. R. J. Gen. Microbiol., 46: 339-46(Mar. 1967).

The effect of modifying agents on the synergistic interaction of uv and γ radiation in the induction of prototrophic revertants of tryptophan-requiring E. coli B/r WP 2 was studied. The component of γ radiation damage involved in the interaction showed a large oxygen effect during irradiation (dose modifying factor of up to three) and was thus more like lethal than mutational damage. The interaction mutants responded to various postirradiation treatments in the same way as uv-induced, but not γ ray-induced, mutants, i.e. they were photoreactivable, their mutation frequency was increased by acriflavine and nutrient broth after irradiation, and they were susceptible to mutation frequency decline in minimal medium. It was postulated that damage induced in DNA by γ radiation inhibited the repair of premutational lesions induced by uv, thus increasing the yield of uv-induced mutants. The possible nature of the system involved in this repair (which is not the system responsible for the excision of thymine dimers in DNA) was discussed. (BBB)

39536 INTERACTION BETWEEN ULTRAVIOLET LIGHT AND γ-RADIATION DAMAGE IN THE INDUCTION OF MUTANTS OF ESCHERICHIA COLI: THE RESPONSE IN STRAINS WITH NORMAL AND REDUCED ABILITY TO REPAIR ULTRAVIOLET DAMAGE. Davies, D. R. (Atomic Energy Research Establishment, Wantage, Eng.); Arlett, C. F.; Munson, R. J.; Bridges, B. A. J. Gen. Microbiol., 46: 329-38(Mar. 1967).

The synergistic interaction between uv light and γ rays for lethal damage was studied in some strains of Escherichia coli. Exposure of tryptophan-requiring E. coli B/r WP2 to uv and γ radiation (in either order) resulted in more revertants than would be expected if the two treatments were independent. The excess mutants (referred to as interaction mutants) were produced in increasing numbers by increasing doses of uv or γ radiation. Evidence was presented that the interaction occurs after irradiation. Although the excision-repair and mutation frequency decline systems for uv damage were not involved in the interaction itself (since a strain deficient in these systems, E. coli WP 2 hcr$^-$, was no less efficient at producing interaction mutants than E. coli B/r WP 2) the uv component involved in interaction was sensitive to one or both of these systems. This was shown by the much lower uv doses at which interaction occurs in E. coli WP 2 hcr$^-$. (BBB)

39537 BASIC LINES OF RESEARCH IN MEDICAL RADIOLOGY AND ROENTGENOLOGY IN THE CURRENT FIVE-YEAR PLAN. Zedgenidze, G. A.; Semenov, V. A.; Cherkasov, V. F.; Elashov, Yu. G.; Filatov, P. E. Med. Radiol., 12: 3-9(Jan. 1967). (In Russian).

The lines of research planned for the 1966 to 1970 period are a further study of the problems of the biological effect of ionizing radiation; a search for methods of treatment and prevention of radiation injury; development of new methods of radioisotope and x-ray diagnosis; a rise in the medical effectiveness of sources of high energy ionizing radiation; and the use of computers in x-ray diagnosis and the programming of radiation treatment. In radiobiology the important problems will include the effect of ionizing radiation on the physical and chemical properties of nucleoproteids and the connection between primary cytogenetic injuries and the matrical structures of the cell nucleus, discovery of the primary mechanisms of radiation cancerogenesis and the characteristics of the reactions of cancer cells to irradiation, the search for methods of early diagnosis and prevention of the hemorrhagic syndrome, methods of stimulating natural immunity and effective methods of preventive vaccination against both acute and chronic radiation injury, a study of the mechanisms of immunological incompatibility of tissue in connection with transplantation of organs and tissues, and a study of the effect of small doses of radiation entering the organism. In the field of radiation hygiene the important problems will include a study of the factors of radiation hazards and effectiveness of safety equipment used in radiation chemistry and accelerators, evaluation of the effectiveness and reliability of present preventive measures and the creation of new means of preventing radiation injuries in connection with contamination of the air with radioactive gases and aerosols. In the field of radiation therapy the important problems will include study of the possibility in increasing the radiosensitivity of tumors with chemical agents and by using the oxygen effect and other methods and procedures; evaluation of individual results of radiation treatment of cancer of the lungs, esophagus, larynx and the blood and hematopoietic organs; further improvement of methods of x-ray therapy in combination with surgical treatment; determination of the optimal

values of the focal dose, the irradiation schedule and the duration of the course of treatment as a function of the histological structure of the tumor and its size; research on clinical use of general external irradiation and internal irradiation to treat patients with systemic malignant ailments; development of medical and technical requirements for new radiological equipment and safety equipment; and a study of the future of Curie therapy. In the field of radioisotope diagnosis the important problems will include refinement of the method of radioisotope diagnosis of tumors of the esophagus and female sex organs by using intracavitary beta-probes; development of methods of early recognition of tumors of the stomach, lungs, liver and kidneys with scanning; the use of radioisotope diagnosis of nontumoral ailments, and further improvement of methods of isotope investigation of the cardiovascular, excretory and endocrine systems, the gastrointestinal tract and the lungs. In the field of x-ray diagnosis important problems include a further study of the forms of roentgenological service to the city and rural population and the development of measures to improve this organization; a search for new and improved methods of x-ray examination of patients; practical introduction of electronic optical transformers, television and cinematography and scientific comparisons of roentgenological data with the results of morphological investigations and the results of other methods of clinical recognition. (JPRS)

39538 RADIATION-INDUCED MORPHOLOGICAL MUTANTS OF ASPERGILLUS NIGER (V_{35}). Mishra, A. K.; Nandi, P. (Bose Inst., Calcutta). Trans. Bose Res. Inst. (Calcutta), 27: 69-76(Sept. 1964).

A strain of Aspergillus niger (V_{35}), isolated from Indian soil, was irradiated by ultraviolet rays. Of the morphological mutants, 859 stable isolates were selected and grouped into seven different types. They were characterized on the basis of their rate of growth and texture of the colonies. They were further characterized by the diffusion of pigment, color of the conidia and mycelium as well as by the microscopical measurement of conidial heads. Nineteen representative isolates from each type were described and their appearances on agar plate cultures were noted. (auth)

39539 DIVISION DELAY INDUCED IN ESCHERICHIA COLI BY NEAR-ULTRAVIOLET RADIATION. Phillips, Stephen L.; Person, Stanley; Jagger, John (Pennsylvania State Univ., University Park. Southwest Center for Advanced Studies, Dallas). J. Bacteriol., 94: 165-70(July 1967).

Beams of near ultraviolet radiation at several principal emission lines of a mercury arc were isolated with a grating monochromator and directed upon cell suspensions. During subsequent incubation at room temperature in nutrient broth, the population was studied by removing samples and obtaining cell numbers and cell size distributions with an electronic cell counter. Division delay without lethality was observed. The shapes of the dose response curves for induction, the doses of near-ultraviolet radiation required, and the action spectrum for division delay were found to be similar to those for growth delay (in broth) and for photoprotection. These findings indicate that all three effects, division delay, growth delay, and photoprotection, are induced by a common type of critical event. Changes in cell size distribution in the culture during incubation in nutrient broth after near-ultraviolet irradiation are very similar for control and irradiated populations, although these changes occur at a much later time in the irradiated population. This indicates that, in nutrient broth, the population recovers completely from the inhibition of growth and division, thus justifying use of the term delay, and suggesting that the damage is nongenetic. (auth)

39540 IMMEDIATE LOSS OF FLAGELLA FROM CHLAMYDOMONAS REINHARDI AFTER ULTRAVIOLET IRRADIATION. Hipkiss, A. R. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Radiat. Bot., 7: 347-9(1967).

When grown in liquid culture the unicellular green alga Chlamydomonas reinhardi is motile by means of two flagella located at its anterior end. It was observed that both these flagella were lost immediately after exposure to nonlethal doses of ultraviolet light. This unexpected effect of uv irradiation, together with the subsequent regrowth of the flagella, is discussed. (auth) (UK)

Radiosterilization and Radiopreservation

Refer also to abstracts 39085, 39142, and 39147.

39541 RECENT TRENDS IN IRRADIATION OF FOOD. Ley, F. J. (Atomic Energy Research Establishment, Wantage, Eng.). Chem. Brit., 3: 298-300(July 1967).

The present usage and future prospects of irradiation of foodstuffs for the purposes of preservation or disinfestation are reviewed. It is pointed out that procedure has been instituted for obtaining official approval for specific processes, in U.K. and other countries. This procedure is outlined and food products cleared for irradiation treatment are enumerated. Studies conducted at the Wantage Research Laboratory, and in America and other countries, are outlined, together with industrial implications. (UK)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstract 40564.

39542 METALLURGIYA TSVETNYKH I REDKIKH METALLOV, 1965. (Metallurgy of Nonferrous and Rare Metals, 1965). Ageev, N. V. (ed.). Seriya Metallurgiya . (Metallurgy Series). Moscow, Institut Nauchnoi Informatsii, 1966. 157p.

Use of extraction methods in the hydrometallurgy of rare and nonferrous metals, ion-exchange processes in hydrometallurgy of metals and alloys, and dispersed inclusions of high-melting compounds and fibers are reviewed. Separate abstracts were prepared for 3 papers. (R.V.J.)

For abstracts of individual papers see: 39005, 39566, and 39674.

Corrosion and Erosion

Refer also to abstracts 39164, 39583, 39603, and 39655.

39543 (AWRE-O-4/62) ATMOSPHERIC OXIDATION OF PLUTONIUM METAL. PART 2. Sackman, J. F. (Atomic Weapons Research Establishment, Aldermaston (England)). [nd]. 27p. Dep. CFSTI. UK.

The oxidation behaviour of α-Pu is shown to be complex and to depend largely on small variations in metallurgical history. Rates of oxidation of different specimens of metal under identical conditions can vary by a factor of up to 40. Under humid conditions, deep cracks appear in the metal after very little oxidation, and these lead to the disintegration of the specimens at an early stage. Attention was paid to the products of oxidation, and both water and CO_2 were shown to be present. (auth)

39544 (BAW-3765-3) CORROSION AND HYDRIDING OF ZIRCALOY. Quarterly Technical Progress Report No. 3, April 1-June 30, 1967. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Aug. 1967. Contracts AT(30-1)-3765; 59-3101. 27p. (EURAEC-1887). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

A better definition of the operational limitations for Zircaloy fuel cladding is presented. During service in water-cooled reactors, Zircaloy cladding will corrode and absorb some of the H_2 released by the corrosion reaction. H_2 adversely affects some of the mechanical properties of Zircaloy; consequently, excessive hydrogen absorption during service could degrade these mechanical properties to the extent that either the operational conditions or the life of the cladding would have to be curtailed. Corrosion and hydriding tests of Zircaloy under heat transfer conditions to determine the quantity of hydrogen absorbed during service, and mechanical property tests of hydrided Zircaloy to determine the effect of H_2 on cladding properties are reported. Gaseous hydriding and oxidation in air have been successful in preparing specimens to simulate fuel cladding after 1000 days service. The hydriding method, however, introduces about twice as much hydrogen in the open-ended tubular and flat strip specimens as in the sealed-tube heat transfer specimens. The hydriding operation is being controlled to introduce the desired quantity of H_2 in the heat transfer specimens. Analytical data indicate that the heat transfer and isothermal loop specimen absorbed considerably more H_2 than did the autoclave specimens. The tensile data show that H_2, at concentrations up to 1000 ppM, has no significant effect on the tensile strength of cold-worked Zircaloy-4 tubing over a temperature range from 70 to 800°F. At temperatures below 250°F and H_2 concentrations above 900 ppM, the tensile elongation of cold-worked tubing is significantly reduced. The elongation values were reduced from 16% for as-received material to less than 6% for material containing 1000 ppM hydrogen. At temperatures above 250°F, elongation is insensitive to hydrogen content, and below 250°F there is no appreciable effect for less than 300 ppM hydrogen on any of the mechanical properties measured. (D.C.C.)

39545 (BNL-11554) THRESHOLD PRESSURES FOR THE REACTION OF SODIUM AND OTHER ALKALI METALS WITH GRAPHITE. Salzano, F. J.; Aronson, S. (Brookhaven National Lab., Upton, N. Y.). [1967]. 8p. (CONF-671102-11). Dep. CFSTI.

For Presentation at 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

No reliable information exists on the phase equilibria or the thermodynamic properties of the Na-graphite system. The results of a calculation of the threshold pressures for the Na-graphite system are presented based on an ionic mechanism of bonding of the alkali metals to the graphitic layers. (W.D.M.)

39546 (EURAEC-1902) THE RELATIONSHIP OF NITROGEN CONTENT OF AUSTENITIC STAINLESS STEELS TO STRESS CORROSION. Quarterly Report No. 438-12. Cox, Thomas B. (Virginia Polytechnic Inst., Blacksburg. Dept. of Metals and Ceramic Engineering). June 1967. Contract AT(40-1)-3208. 14p. Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

The results from stress corrosion tests performed in Type 304 stainless steel plates are presented. The plates were subjected to various N_2 bearing atmospheres for 24 hr at 538°C. To make certain that the specimens were homogeneous in nitrogen content, they were encapsuled individually under a vacuum in quartz tubing and held at an elevated temperature for annealing. Annealing results for 1800°F and 2000°F are presented. (D.C.C.)

39547 (ORNL-TM-1907) CORROSION OF THE VOLATILITY PILOT PLANT INOR-8 DISSOLVER AFTER SEVEN COLD DISSOLUTION RUNS. Moncrief, E. C.; Litman, A. P. (Oak Ridge National Lab., Tenn.). July 21, 1967. Contract W-7405-eng-26. 9p. Dep. CFSTI.

Ultrasonic thickness measurements to determine corrosion losses in an INOR-8 dissolver vessel after 204 hrs. exposure to anhydrous HF and equi-molar NaF-LiF fused salt containing 22 to 52 mole % ZrF_4 at 459 to 655°C, while Zircaloy-2 dummy fuel elements were being dissolved, show that maximum losses occurred in the vapor region, lower losses in the vapor-salt interface region, and still less losses in the salt region of the vessel. (P.G.C.)

39548 (UCID-15190) A METHOD FOR ESTIMATING THE SOLUBILITIES OF REFRACTORY METALS IN LIQUID METALS: EFFECTIVE SOLUBILITY PARAMETERS. Pasternak, A. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 2, 1967. Contract W-7405-eng-48. 13p. Dep. CFSTI.

A method is presented for predicting the solubilities of pure refractory metals in liquid metals. The solubility of one refractory in the liquid metal is determined and with the pure-component thermodynamic data the solubilities of other refractories in the same liquid metal may be estimated. The method is limited to systems which do not form intermetallic compounds. The technique is demonstrated on data for the solubilities of Nb, Ta, and W in liquid Pu. Solubilities of refractory metals in liquid metals are required to ascertain corrosion problems which arise in liquid metal heat transfer loops and boilers such as those proposed for space power electric generation systems. (J.C.W.)

39549 EFFECT OF TEMPERATURE ON STRESS-CORROSION FRACTURE. Sylwestrowicz, W. D. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Corrosion, 23: 245-51(Aug. 1967).

Prestrained samples of Cu-Be alloy (1.8 Be, 0.3 Co) were exposed to an NH_3 atmosphere at -20, 30 and 90°C (-4, 86, 194°F). The effect of temperature was related to the amount of plastic deformation. Above a critical value of plastic prestrain, temperature effect reverses; a longer exposure was needed to fracture a sample at 90 than at 30°C. This temperature dependence is explained by considering the number and distribution of dislocations. (auth)

39550 OXIDATION OF SERIES OF DILUTE Zr ALLOYS AT 500 C IN WATER VAPOR ATMOSPHERE CONTAINING TRACE AMOUNTS OF OXYGEN. Gulbransen, Earl A.; Andrew, Kenneth F. (Westinghouse Research Labs., Pittsburgh). Corrosion, 23: 231-5(Aug. 1967). (WERL-3203-6).

A flow-type reaction system was used to study the water-vapor reaction of a series of dilute Zr alloys at 500°C (932°F). These alloys included Zircaloy-2, Zircaloy-4, the eutectoids (w/o) Zr-1.0 Cr, Zr-1.3 Ni, and Zr-5.0 V. Pure Zr was included for comparison. Both H_2 and O_2 uptakes were measured for times up to 237 hrs. H_2-uptake curves showed small amounts of H_2 were picked up for weight gains below 1000 $\mu g/cm^2$. Above this weight gain the H_2 uptakes were 25 to 30% theoretical. A model was proposed for the reaction. (auth)

39551 OXIDATION PROTECTION OF ZIRCONIUM AT HIGH TEMPERATURES. Darras, R.; Koch, P. (CEA-CEN, Saclay, Gif-sur-Yvette, France). J. Nucl. Mater., 23: 98-102(July 1967). (In French).

The use of Al films for the oxidation protection of Zr was investigated. Zr plates were polished, rinsed, dried, and placed in

a vacuum where Al was deposited by thermal evaporation. This deposit was consolidated by thermal treatment under vacuum. The thermal treatment lead to the formation of a thin surface layer of Al–Zr intermetallic compound. Oxidation tests showed that Al coating stops almost all formation of oxide on the Zr in CO_2 at 600°C. (J.S.R.)

39552 ELECTROCHEMICAL CORROSION EXPERIMENTS AT TEMPERATURES ABOVE 100°C. Spaepen, G. J.; Fevery-DeMeyer, M. J. (Centre d'Etude de l'Energie Nucleaire, Brussels). Corros. Sci., 7: 405-12 (July 1967).

A description is given of a cell with three electrodes — reference, measuring and current electrodes — which permits electrochemical corrosion measurements at temperatures higher than 100°C and at corresponding pressures. The system consists of a cell normally used for room temperature work enclosed in a pressure chamber. Inside the pressure chamber a dry gas is automatically kept at such a pressure as to minimize pressure differences across the cell wall. A few examples of measurements on stainless steel and aluminium are discussed. The passivity and pitting behaviour of stainless steel in chloride solutions are expressed as a function of temperature, and the cathodic nature of aluminium at high temperatures is demonstrated. (auth) (UK)

39553 CORROSION AND HEAT TRANSFER: A REVIEW. Ross, T. K. (Univ. of Manchester Inst. of Science and Tech., Eng.). Brit. Corros. J., 2: 131-42 (July 1967).

The general features of heat exchange phenomena are reviewed, and their influence upon corrosion processes in liquids is outlined. The experimental techniques previously used are surveyed and new techniques based upon an analysis of the problem are suggested. Data obtained by these methods are illustrated with some results obtained on mild steel, Cu and Al. 44 references. (auth) (UK)

39554 EFFECT OF OXYGEN AND NITROGEN IN TANTALUM ON ITS RESISTANCE TO CORROSION BY LIQUID PLUTONIUM ALLOYS. Litton, F. B.; Perkins, R. H. (Los Alamos Scientific Lab., N. Mex.). Nucl. Appl., 3: 556-9 (Sept. 1967). (LA-DC-8647).

The effect of O_2 and N_2 content of Ta on its resistance to corrosion by molten Pu–Ce–Co alloys was investigated. The impurity content of the Ta ranged from 100- to 4400-ppm oxygen and from 20- to 1000-ppm nitrogen. The test was completed in five cycles over a period of 4700 h at 650°C. Plutonium penetration occurred at the closure welds through cracks attributed to mechanical stress from expansion of the fuel alloys on freezing and did not occur in capsules prepared from high-purity Ta. (9 references) (auth)

39555 KORROZIYA TSIRKONIYA I EGO SPLAVOV. (Corrosion of Zirconium and its Alloys). Parfenov, B. G.; Gerasimov, V. V.; Venediktova, G. I. Moscow, Atomizdat, 1967. 260p.

The properties of Zr and its alloys are reported. Studies on their corrosion properties and hydration under conditions of their use in nuclear-reactor construction were compiled and systematized. Effects of light alloying elements, thermal processing, and other factors on the corrosion and hydration of Zr alloys were examined. Electrochemical behavior of Zr in aqueous solutions was examined. Data on the effect of hydration and irradiation on the oxidation and mechanical characteristics of the alloys were compiled. Existing theories on the mechanism of corrosion rupture were analyzed and new hypotheses on the mechanisms of corrosion and hydration, which is the most common phenomenon observed during oxidation of Zr and its alloys, were proposed. On the basis of the theoretical studies, recommendations were made on the rational alloying of Zr for obtaining desired corrosion and hydration characteristics during the use of Zr alloys under different conditions. (tr-auth)

Preparation and Fabrication

Refer also to abstracts 39093, 39643, 39676, 39678, 39833, 40713–40717, and 40732.

39556 (AD-651191) METALLIC-CERAMIC AND INTERMETALLIC COMPOUNDS BY THE FLOATING ZONE TECHNIQUE. Progress Report No. 1, October 1, 1965–September 30, 1966. (Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.). Mar. 6, 1967. 23p. (NAEC-AML-2559). CFSTI.

The floating zone process was used to prepare Nb–Al_2O_3 cermets and the intermetallic compound NiAl. Small amounts of Al_2O_3 hardened Nb, and higher concentrations of Al_2O_3 formed a series of metallic and nonmetallic phases. Zone melting a Ni tube with an Al rod inside produced a small amount of what appeared to be NiAl. (P.G.C.)

39557 (HA-2338) FINAL REPORT OF INVESTIGATION ON DEVELOPMENT OF SOLID STATE BONDING TECHNIQUE. Long, James R.; Davis, LeRoy W. (Harvey Engineering Labs. for Research and Development, Torrance, Calif.). [1967]. Contract NAS8-20384. 67p.

Process techniques for roll bonding Be to Be and Be to Ti to produce rib-stiffened panels for space vehicle application are presented. The experimental work covered hot rolling of Be pieces in contact with each other held in position with steel spacers and enclosed in welded steel jackets. Samples were rolled at temperatures from 1400 to 1700°F at reductions of 5 to 15% per pass with total reductions from 20 to 75%. Direct bonding of Be to Be was successfully accomplished by rolling at 1550°F with as low as 40% reduction. Bonding of Be to Ti was unsuccessful. No bonding of the Be to the steel spacers or jacket material was encountered. The bonds made were chiefly flat lap bonds with complete overlap of the pieces. Bonds were also made with Ag foil between the mating surfaces. Partial lap bonds simulating isolated thick pads on thin sheet were not successful by this technique with or without the use of silver foil. Bonding of Be strips to form an I-beam configuration was partially successful. Only one flange was firmly bonded forming a Tee section, and this only when silver foil was used at the contact surfaces. The overall results of the work demonstrate that Be to Be bonds can be made by this process and indicate a need for further development work to refine the process and further define its limitations. (auth)

39558 (N-67-19961) RESEARCH ON MECHANISMS OF ALLOY STRENGTHENING. I. ALLOY STRENGTHENING BY FINE OXIDE PARTICLE DISPERSION. II. THE SPLAT COOLING PROCESS FOR ALLOY DEVELOPMENT. Grant, Nicholas J. (Massachusetts Inst. of Tech., Cambridge, Dept. of Metallurgy). Dec. 1966. 12p. (NASA-CR-82972). CFSTI.

The processing and extrusion of five Fe–Be alloy powders are discussed along with the production of Cu-Al_2O_3 powders of approximately 44 microns diameter by a liquid atomization technique. Cr_2O_3 control in oxidation resistant oxide dispersion strengthened alloys is reported, and consideration is given to the internal oxidation of thin Ni–Al foils. Modes of deformation and fracture in oxide dispersed metal systems are summarized, and an oxidation treatment was selected for the internal oxidation of ⅛ in. thick, cold rolled dilute Cu–Al alloys. The splat cooling process for alloy development was investigated, and includes the development of continuously operating atomization units for large scale powder production. Included are studies of the decomposition of supersaturated Al–Si alloys, dendritic spacing in Al alloys, solubility limits of Al–Cu, Al–Ni, and other binary systems, and Cu-base alloy systems. (auth)

39559 (N-67-20010) INVESTIGATION OF THE REINFORCEMENT OF DUCTILE METALS WITH STRONG, HIGH MODULUS DISCONTINUOUS BRITTLE FIBERS. Quarterly Report. Gatti, A.; Berry, J. M.; Gebhardt, J. J.; Feingold, E. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). Mar. 10, 1967. Contract NASw-1543. 32p. (NASA-CR-82998; QR-1). CFSTI.

Preliminary results from a program to define and investigate the critical factors affecting the reinforcement of ductile metals with short, brittle fibers are presented. The materials system selected for study is Al (or its alloys) reinforced with B_4C fibers or whiskers. Details are given on the growth of B_4C whiskers by a chemical vapor deposition process, testing of the matrix metal in uniaxial tension, pulling of individual W-core filaments of B_4C in tension and a statistical study of their strength and elastic modulus, use of a hot-pressing technique to fabricate single filament composites consisting of B_4C/W filaments imbedded in the pure Al, fracture behavior of single filament composites, and fracture behavior of single-filament composite specimens made at increasing test temperatures so that the fracture mode of the filament could be observed as a function of the decreasing shear strength of the matrix. (auth)

39560 (NLCO-994) OBSERVATION OF THE ELECTROLYSIS OF UO_2 AT MALLINCKRODT CHEMICAL WORKS, WELDON SPRING, MISSOURI FROM JUNE 1, 1966–OCTOBER 7, 1966. Lusky, R. J.; Brodi, G. (National Lead Co. of Ohio, Cincinnati). May 1967. Contract AT(30-1)-1156. 23p. Dep. CFSTI.

From observations at Mallinckrodt Chemical Works it was concluded that the electrolysis of UO_2 to U is technically feasible in laboratory and pilot plant studies, but the economic feasibility of the process was not demonstrated. The large-scale operation was plagued by insufficient cathode current density, excessive anode current density, unsatisfactory methods of heating and heat transfer, and inadequate materials of construction. (D.H.M.)

39561 (NLCO-1001, pp 4.1-38) SOLIDIFICATION OF URANIUM PRODUCTION INGOTS. Olson, K. E.; Eikenberry, H. M. (National Lead Co. of Ohio, Cincinnati).

The solidification rates of 8, 9, and 11-in. uranium ingots were

measured. The effect of pouring temperature on the structures, nonmetallic inclusions, surfaces, and porosity was ascertained. (auth)

39562 (UCRL-13307) RESEARCH AND DEVELOPMENT ON ADHESIVES FOR URANIUM AND THORIUM. Final Report. Glasgow, D. G.; Salyer, I. O. (Monsanto Research Corp., Dayton, Ohio). Oct. 1964. Contract W-7405-eng-48; Subcontract 212. 91p. Dep. CFSTI.

For Univ. of California Lawrence Radiation Lab., Livermore.

An accelerated aging procedure was developed for aging the uranium lap joints used in this study. The conditions of 140°F and 80% relative humidity (RH) were found adequate to rapidly destroy uranium-to-uranium joints bonded with a commercial, unfilled, epoxy adhesive. A correlation between accelerated aging and shelf-life aging (aging at approximately 20 to 25°C and 40 to 90% RH) was determined. A minumum value of 30 days of "ambient" shelf life aging per day of accelerated aging was found. Six amines were tested as curing agents for Epon 828 adhesives. They were diethylenetriamine, tetraethylenepentamine, hexamethylenediamine, bis(hexamethylene)triamine, octamethylenediamine, and decamethylenediamine. Metallic fillers, particularly aluminum, extend the useful lifetime of an amine-cured epoxy adhesive. A mechanism to explain this effect was proposed. A study was carried out to find the best particle shape and size of aluminum fillers to use in various amine-cured epoxy adhesives. Sixteen particle sizes and shapes were tested using five different amines as curing agents. The effect of filler concentration on retention of tensile shear strength was investigated and the optimum level established. The influence of room temperature cure vs heat cure and the effects of degassing on the tensile shear strength retention of various adhesives were also evaluated. Promising aluminum-filled, amine-cured epoxy adhesives were subjected to long-term, accelerated aging in order to find the best adhesive of this type. Anhydride-cured epoxies, novolac-modified epoxies, as well as polyethylene and ethylene–acrylic acid copolymers, were tested as uranium adhesives. The ethylene–acrylic acid adhesives were also tested with other metal systems. Two reactive primers, 10,11-epoxyundecanoic acid and p-hydroxybenzoic acid, applied as monolayers, were tested to determine their effect on tensile shear strength and on tensile shear strength retention. A study of the use of protective coatings in combination with various adhesives in an attempt to provide a long-term adhesive was carried out. Protective coatings were tested in combination with amine-cured epoxy adhesives, primed U bonded with an amine-cured epoxy adhesive, and with Al-filled, amine-cured epoxy adhesives. Stearic acid, sebacic acid, perfluorooctanoic acid, and perfluorooctanol multilayers were all used as protective coatings. Several other types of materials were tested as adhesives for U to determine whether or not any were better than amine-cured epoxy adhesives. Polyurethanes, various polyethylenes, a polyamide, a polyester and three thermosetting vinyl polyesters were studied. A detailed study of methods for obtaining complete monolayers of stearic acid on U for use as protective coatings was carried out. Several other acids and two alcohols were also used as protective coatings. (auth)

39563 (LA-tr-67-63) SUBLIMATION PRESSURES AND SOME THERMODYNAMIC PROPERTIES OF ZIRCONIUM AND HAFNIUM TETRACHLORIDES. Funaki, K.; Uchimura, K. Translated for Los Alamos Scientific Lab., N. Mex., from Denki Kagaku, 33: 167-71(1965). 12p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

Results of experiments to determine sublimation temperatures of $ZrCl_4$ and $HfCl_4$ are reported. Comparisons are made with results obtained by previous investigators. Sublimation temperature of $ZrCl_4$ was 334 ± 2°C and for $HfCl_4$ 320 ± 2°C. (P.G.C.)

39564 (ORNL-tr-1743) ANODIC DEPOSITION OF CURIUM. Letter to the Editorial Staff. Haissinsky, Moise; Pluchet, Elisabeth. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from J. Chim. Phys., 64: 737-8(1967). 4p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

Procedures involved in anodic deposition of Cm are described. It was determined that the maximum depositable quantity of Cm at 1.55 V, from a solution originally of one-tenth the concentration (3×10^{-3} M) is one-thirtieth. Normal NaOH did not attack the deposit even without current flowing, but H_2O_2, 0.1N HF, hydrazine, cerous nitrate, and uranyl nitrates dissolved it rapidly. (P.G.C.)

39565 A STUDY OF THE STRAIN-AGE CRACKING CHARACTERISTICS IN WELDED RENE 41: PHASE I. Hughes, W. P.; Berry, T. F. (General Electric Co., Cincinnati). Weld. J. (N.Y.), 46: 361.s-70.s(Aug. 1967).

Research was conducted for better understanding of the strain-age cracking that occurs in nickel-base alloys. René 41 was selected as representative of this class of alloys. A hypothesis was proposed that strain-age cracking is the result of the summation of residual welding, aging contraction, and thermal stresses acting on the heat-affected zone at a time when this zone is being embrittled by metallurgical reactions. Effects of chemical variations, mill processing, and welding variables on the sensitivity of René 41 to strain-age cracking were studied. The following conclusions were made: The amount of time to encounter strain-age cracking at any exposure temperature subsequent to welding appeared extremely dependent on the magnitude and state of stress imposed on the heat-affected zone of the weld. The incidence and severity of strain-age cracking was affected by the cooling rate from a time-temperature exposure, which produced a crack-sensitive microstructure. The severity of cracking increased with increased cooling rates. The use of high-purity raw materials (low Fe, Si, and Mn) during melting of René 41 increased the resistance of René 41 to strain-age cracking. Increasing the thickness 0.060 to 0.250 in. greatly increased sensitivity to strain-age cracking. Sensitivity of René 41 was significantly reduced by using the electron-beam process rather than the gas tungsten-arc process. However, the joint gaps required for electron-beam welding were much less than for gas tungsten-arc welding. A specimen design and testing procedure using Gleeble equipment was also developed. (P.C.S.)

39566 ION-EXCHANGE PROCESSES IN HYDROMETALLURGY. Kuznetsov, V. A. pp 67-113 of Metallurgiya Tsvetnykh i Redkikh Metallov, 1965. Ageev, N. S. (ed.). Moscow, Institut Nauchnoi Informatsii, 1966. (In Russian).

Ion-exchange processes in hydrometallurgy of nonferrous and rare metals published during the years of 1963 to 1965 are reviewed. Ion-exchange technology of U and V is discussed. The relation of various anions to the anion exchange resins was tabulated according to the magnitudes of the partial molar entropy of ions. Tables are also given on the type of various ionite applications for various metals and conditions. Applications of ion-exchange processes in hydrometallurgy of transuranic elements and thorium metals are evaluated. (144 references). (R.V.J.)

39567 HIGH YIELD ^{233}U CASTING OPERATIONS. Gilmore, R. R.; Harbur, D. R. (Los Alamos Scientific Lab., N. Mex.). Mod. Cast., 49: No. 6, 135-8(June 1966). (LA-DC-7510).

The equipment and procedure for casting ^{233}U to prevent the serious problems due to volume change on freezing are described. The mold is described in detail as to material and type of construction. The method involves the directional solidification of the ^{233}U from top to bottom, and the proper safety precautions necessary for handling the ^{233}U are described. (B.L.M.)

39568 THE INFLUENCE OF OXYGEN ON WETTING AND BONDING IN THE COPPER–TUNGSTEN SYSTEM. Nicholas, M.; Poole, D. M. (Atomic Energy Research Establishment, Harwell, Eng.). J. Mater. Sci., 2: 269-74(May 1967). (AERE-R-5255).

The purity of Cu has a marked influence on its ability to wet and bond to W. Spectroscopically pure Cu readily wetted W, even at 1088°C, and produced bonds with room-temperature shear strengths of 12.5 t/in.^{2}; high-conductivity Cu did not wet at temperatures below 1125°C and produced bonds with strengths of only 1.85 t/in.^{2}. This difference in behavior was thought to be related to the O content of the Cu, because metallographic examination showed wetted samples to have clean interfaces, and nonwetted samples to have a purple-brown layer at the interface. The influence of the O content of Cu on its wetting of, and bonding to, W was investigated using sessile-drop and pull-out strength tests. As little as 41 ppM of O was found to inhibit wetting and to result in bond strengths of less than 2 t/in.^{2}. (BBB)

39569 TEXTURES OF EXTRUDED BAR AND TUBE AND DRAWN WIRE OF Be. Mishima, Yoshitsugu; Okubo, Tadatsune (Tokyo Univ.). Sogo Shikensho Nempo, 24: No. 2, 89-91(Mar. 1966). (In Japanese).

Pole figures of the textures in a square bar, a round bar, and a tube extruded at 1,000 to 1,100°C from hot-pressed Be were determined. A square bar had a single fiber texture, in which the extruding direction made an angle of 15 to 20° and 75 to 70° with $[10\bar{1}0]$ and [0002], respectively. In the round bar, the extruding direction was parallel to $[10\bar{1}0]$. The tube had the texture of high symmetry, in which [0002] was parallel to the radial direction of the tube and $[10\bar{1}0]$ was parallel to the extruding direction. Besides, a wire was drawn from the hot-extruded round bar, in which $[10\bar{1}0]$ fiber texture was observed. (NSA of Japan)

39570 NEW ZIRCONIUM ALLOY. (to Siemens-Schuckertwerke A.G.). French Patent 1,343,131. Oct. 7, 1963. Priority date Sept. 29, 1962, Germany.

A Zr alloy, useful as canning material for fuel elements, consists of Zr, 0.1–0.5% Nb and 0.005–1.0% Y, other constituents

may be 0.2–1% Sn, 0.5–1.5% Cu, 0.1–1.5% Fe, 0.1–1.5% Cr, 0.1–1.5% Ni, 0.5–1% Mo, 0.5–1% W, 0.2–1% V. Said alloys show an improved corrosion resistance in superheated steam. (NPO)

39571 METHOD FOR FIRMLY BONDING A METAL JACKET TO A METAL-CERAMIC BODY. (to United Kingdom Atomic Energy Authority). French Patent 1,376,907. Sept. 21, 1964. Priority date Nov. 22, 1962, Great Britain.

A process is described for bonding UO_2–SS fuel bodies to a SS can. The bodies are impregnated with Cu, coated with a Cu or Ag brazing agent and inserted in the can. The assembled fuel element is subjected to hydrostatic pressure and simultaneously heated to melt the brazing agent. (NPO)

39572 NIOBIUM ALLOY FOR HIGH TEMPERATURES. (to United Aircraft Corp.). French Patent 1,357,954. Mar. 2, 1964. Priority date May 18, 1962, United States.

A Nb alloy with good strength properties and oxidation resistance up to 1200°C, consists of Nb and 0.05 to 0.3% Be. Other constituents may be 1 to 40% Ta, W and/or Mo, 0 to 10% Hf, Zr and/or V and 0 to 4% Cr. The alloy can be rolled at 980° and annealed at 1650°C. The alloy can be applied in gas turbines and in nuclear reactors. (NPO)

39573 BERYLLIUM–MAGNESIUM ALLOY. (to CEA. Pechiney Compagnie de Produits Chimiques et Electrometallurgiques). French Patent 1,361,947. Apr. 20, 1964. Filed Mar. 14, 1963.

A Be–Mg alloy, containing 0.05 to 0.5% (preferably 0.2%) Mg was developed as a canning material for fuel elements for nuclear reactors that are cooled with humid CO_2. These alloys show an improved corrosion resistance compared to commercial Be and Be–BeO alloys. (NPO)

39574 ZIRCONIUM ALLOY. (to Associated Electrical Industries Ltd.). French Patent 1,266,014. May 29, 1961. Priority date June 22, 1959, Great Britain.

Zr alloys with improved corrosion resistance, useful as construction material in CO_2 cooled reactors, consist of Zr, 0.5 to 1.5% Cu and 0.25 to 1.5% W. (NPO)

39575 MAGNESIUM ALLOYS FOR NUCLEAR REACTORS. (to Magnesium Elektron Ltd.). French Patent 1,355,533. Feb. 10, 1964. Priority date Aug. 11, 1961, Great Britain.

Nuclear reactor fuel element cans are manufactured by extrusion of an alloy powder, consisting of Mg, 0.1 to 1% Zr, 0 to 0.25% Mn and 0 to 0.01% Be followed by a heat-treatment at circa 600°C or at 300°C in a H_2 atm. (NPO)

39576 ALLOY STEELS. (to United Kingdom Atomic Energy Authority). French Patent 1,356,686. Feb. 17, 1964. Priority date May 11, 1962., Great Britain.

Steel for nuclear reactor pressure vessels contains 0.10 to 0.14% C, 1.0 to 1.2% Mn, 0.12 to 0.18% Si, 1.5 to 1.7% Ni, 0.25 to 0.32% Mo, 0.08 to 0.12% V, 0.45 to 0.55% Cr, less than 0.25% Nb, and less than 0.04% S and P. (NPO)

39577 ZIRCONIUM ALLOYS. (to Associated Electrical Industries Ltd.). French Patent 1,377,841. Sept. 28, 1964. Priority date Dec. 19, 1962, Great Britain.

A corrosion resistant Zr alloy, particularly useful as construction material for vapor generating pressure tubes in heavy water moderated reactors, consists of Zr, 0.5 to 1.5% Cu, 0.25 to 1.5% W and 0.2 to 3.0% Nb. (NPO)

39578 BINARY ZIRCONIUM ALLOYS. (to CEA). French Patent 1,373,048. Aug. 17, 1964. Filed June 26, 1963.

A Zr alloy, useful for parts of CO_2 cooled nuclear reactors, consists of Hf free Zr and 2 to 6%, preferably 4% Cu. (NPO)

39579 TERNARY ZIRCONIUM ALLOYS. (to CEA). French Patent 1,375,058. Sept. 7, 1964. Filed June 26, 1963.

A ternary alloy, useful as structural material in CO_2 cooled nuclear reactors, consists of Hf free Zr, 0.5 to 3% V and 0.5 to 3% Cu. (NPO)

39580 ALUMINUM ALLOYS. (to United Kingdom Atomic Energy Authority). French Patent 1,177,396. Dec. 1, 1958. Priority date June 21, 1956, Great Britain.

Al alloys with improved resistance to aqueous corrosion at high temperature and pressures, which are useful for canning fuel elements, as matrices for dispersion fuels or as constituent of fuel alloys, consist of Al, 0.5 to 2.5% Nb, 0.1 to 0.3% Ti, and preferably also of 0.1 to 1% Fe, 0.05 to 0.5 Si and 0.005 to 0.10 Be. (NPO)

39581 NEW ZIRCONIUM ALLOY. (to Siemens-Schuckertwerke A.G.). French Patent 1,344,069. Oct. 14, 1963. Priority date Sept. 29, 1962, Germany.

A Zr alloy, useful for canning fuel elements or as structural material for nuclear reactor parts, particularly those which are exposed to superheated steam, consists of Zr, 0.005–1.0% Ce, 0.1–0.5% Nb and one or more of the following constituents: 0.2–1% Sn, 0.1–1.5% Cu, 0.1–1.5% Fe, 0.1–1.5% Cr, 0.1–1.5% Ni, 0.5–1% Mo, 0.5–1% W, 0.2–1% V. (N.P.O.)

39582 ZIRCONIUM ALLOYS. (to CEA). French Patent 1,337,240. Aug. 5, 1963. Filed Apr. 27, 1962.

Zr alloys, useful as constructional material for CO_2 cooled nuclear reactors, consist of Zr and 0.1–3% V. Said alloys show an improved corrosion resistance. (N.P.O.)

39583 METHOD OF PROTECTING MAGNESIUM PARTS. (to CEA). French Patent 1,408,882. July 12, 1965. Filed July 9, 1964.

A method for applying a protecting nitride layer on structural parts, particularly Mg or a Mg-alloy as Mg-0.6% Zr fuel element cans for gas cooled reactors is described. The nitride layer is formed by heating said parts in a N_2-atm. above 550°C; the treatment can be executed in the reactor itself by mixing the coolant gas (CO_2) with N_2, the partial pressure of the N_2 then being at least 1 bar. The nitride layer prevents sublimation and unwanted diffusion phenomena. (NPO)

39584 SINTERED BERYLLIUM PARTS AND THEIR METHOD OF MANUFACTURE. (to United Kingdom Atomic Energy Authority). French Patent 1,289,662. Feb. 26, 1962. Priority date Mar. 4, 1960, Great Britain.

Density fluctuations in sintered Be parts are avoided if care is taken that the Al and Si content of the Be powder lies between 500 and 2000 ppM. (NPO)

39585 IMPROVEMENTS IN ZIRCONIUM ALLOYS. (to Metropolitan-Vickers Electric Corp. Ltd.). French Patent 1,199,996. June 22, 1959. Priority date July 26, 1957, Great Britain.

A corrosion resistant alloy for use in CO_2 cooled reactors consists of Zr, 0.5–1.5% Cu, 0.25–1.5% Cr and/or Mo and less than 100 ppM Al and Ti. The alloy is heat-treated at 850–950°C, suddenly cooled and again heat-treated below 850°C to improve its mechanical properties. (NPO)

39586 ZIRCONIUM ALLOYS FOR THE CONSTRUCTION OF NUCLEAR FUEL ELEMENTS. (to Associated Electrical Industries Ltd.). French Patent 1,281,198. Nov. 27, 1961. Priority date Mar. 1, 1960, Great Britain.

Zr alloys that are creep resistant above 500°C contain 0.25–3% Cu, 3–7% Nb and 0.25–3% Mo. (NPO)

39587 ZIRCONIUM ALLOY. (to Siemens-Schuckertwerke A.G.). French Patent 1,408,152. July 5, 1965. Priority date Mar. 24, 1962, Germany.

A Zr alloy for fuel element cans or other structural parts of steam cooled reactors, consists of Zr, 0.1–5% (preferably 0.3–2.5%) Nb, 0.1–3% (preferably 0.5–1.5% Cu) and one or more of the following constituents: 0.2–1% Sn, 0.1–1.5% Fe, Cr, Ni, 0.5–1% Mo, W, 0.2–1% V, 0.1–1% Ta, Pd, 0.01–1% Ca. (NPO)

39588 URANIUM ALLOYS. (to United Kingdom Atomic Energy Authority). French Patent 1,381, 990. Nov. 2, 1964. Priority date Feb. 11, 1963, Great Britain.

A U alloy containing 0.8–1.2 at. % Mo and Nb is heat treated at 700–900°C and then quenched at a velocity of 100–250°C/min. The result is a grain size of 50–100 microns. (NPO)

39589 NEW URANIUM ALLOYS FOR NUCLEAR FUELS. (to C.E.R.C.A.). French Patent 1,410,253. Aug. 2, 1965. Filed July 1, 1964.

Quaternary U–Cr–Ge–Zr fuel alloys, containing 0.02–0.3% Cr and Ge and 0.01–0.3% Zr show a fine grain structure if continuously cooled immediately after casting. (NPO)

39590 NUCLEAR FUEL MATERIALS. (to United Kingdom Atomic Energy Authority). French Patent 1,417,692. Oct. 4, 1965. Priority date Dec. 17, 1963, Great Britain.

Three types of U alloys are designated: (1) 100–500 ppM Al, 100–650 ppM Fe (Al + Fe > 350 ppM), balance U, (2) 1200–1500 ppM Al, 200–650 ppM Fe, balance U, and (3) 150–1500 ppM Al, 100–200 ppM Fe (Al + Fe > 350 ppM), balance U. The alloys are β-quenched and α-annealed. They are particularly useful as nuclear fuels. (NPO)

39591 MANUFACTURE OF AN IMPROVED ZIRCONIUM–ALUMINUM ALLOY. (to U.S. Atomic Energy Commission). French Patent 1,283,427. Dec. 26, 1961. Priority date Feb. 26, 1960, United States.

A Zr alloy with improved mechanical and corrosion resistance properties contains 3–10% Al, 0.1–4% Mo, 0.05–1% Be and 0–1% B. (NPO)

39592 SLIGHTLY ALLOYED URANIUM ALLOYS. (to CEA). French Patent 1,378,895. Oct. 12, 1964. Filed Aug. 7, 1963.

Fine-grained U alloys which can be used as nuclear fuels without a preliminary heat-treatment consist of 0.10–0.30% Mo, 0.05–0.15% Cr, 0.01–0.05% Fe, balance U. (NPO)

39593 METHOD OF MANUFACTURING FUEL ELEMENTS. (to Nuclear Developments Ltd.). French Patent 1,428,410. Jan. 3, 1966. Priority date Mar. 13, 1964, Great Britain.

Fuel elements, consisting of a U bar in a Magnox sheath, can experience severe distortion in the reactor in case of sheath failure. This is prevented by a preliminary anodization of the U bar in an electrolyte, consisting of 25 vol % NH_3, 50 vol % ethylene glycol and 25 vol % H_2O, immersing the anodized bar in Mg or Magnox powder and heating the composite in Ar in the presence of UBr_4 at about 600°C, resulting in the formation of a Mg or Magnox coating on the bar. The coated bar is then thermopneumatically canned in a Magnox sheath. (NPO)

39594 NUCLEAR FUEL MATERIALS. (to United Kingdom Atomic Energy Authority). French Patent 1,417,620. Oct. 4, 1965. Priority date Dec. 17, 1963, Great Britain.

A U–Al fuel alloy is reported which contains 100 to 1500 ppm Al and such a quantity of Cr, Mo, Rh, Ir, Os, Re, Ru, Ni, Co, Pt, W, V, Mn, Si, or Nb that the grain size developed is <0,5 mm. Preferred additions are 200 to 500 ppm Si or <500 ppm Nb. Said alloys are β-quenched and α-annealed. (NPO)

39595 METHOD OF COATING URANIUM RODS. (to CEA). French Patent 1,377,354. Sept. 28, 1964. Filed Aug. 9, 1963.

A canned U rod is provided with a corrosion resistant interlayer by wrapping a Zr or Cu strip around the U core, degasifying the composite rod and heating it in vacuum at 650 to 800°C or at 650°C respectively to cause the strip metal to diffuse into the U. A device for the coating operation is described. (NPO)

39596 METHOD OF COATING URANIUM RODS. (to CEA). French Patent 1,407,721. June 28, 1965. Filed June 22, 1964.

A U-bar is first vapor coated with one of the metals Zr, Cu, Cr or Si, then coated with another of said metals and finally subjected to a heat treatment to effect diffusion of the second coating into the first one. The composite coating serves as corrosion resistant interlayer in the canned fuel rod. (NPO)

39597 IMPROVEMENTS IN URANIUM ALLOYS. (to United Kingdom Atomic Energy Authority). French Patent 1,381,989. Nov. 2, 1964. Priority date Feb. 11, 1963, Great Britain.

U alloys containing 0.1 to 0.6 at. % Cr and 0.1 to 1.2 at. % Nb are annealed at 775 to 900°C and then quenched at a velocity of 100 to 250°C/min. The resulting alloys have a grain size of 50 to 120 microns. (NPO)

39598 METHOD OF COATING URANIUM RODS. (to CEA). French Patent 1,377,354. Oct. 25, 1965. Filed June 22, 1964.

An addition to Fr. Patent 1.377.354 specifies that the coating strip can also consist of Al, Nb or Ni, the diffusion treatment then being effected at 600 to 800°C, 750°C or 600 to 800°C respectively. (NPO)

39599 IMPROVEMENTS IN URANIUM ALLOYS. (to United Kingdom Atomic Energy Authority). French Patent 1,355,191. Feb. 3, 1964. Priority date Apr. 19, 1962, Great Britain.

A U fuel alloy contains ⅛ to 1½ at. % Mo, 400 to 1500 ppM Al and 325 to 500 ppM Fe. Said alloy is β annealed at 680 to 750°C, rapidly cooled to 450 to 550°C and maintained at the latter temperature to effect the transformation in the α-phase. (NPO)

39600 IMPROVEMENTS IN THIN CANS FOR FUEL ELEMENTS. (to CEA). French Patent 1,302,470. July 23, 1962. Filed June 12, 1961.

Stainless steel, thin-walled tubular cans are provided with radial, longitudinal or helical folds for compensation of differential dilations. Radial folds are preferably located at both ends of the cans. (auth)

39601 CAN FOR NUCLEAR FUEL ELEMENT. (to CEA). French Patent 1,410,264. Aug. 2, 1965. Filed July 10, 1964.

Binary Mg–Y-alloys were developed for cans of fuel elements to be used in gas-cooled natural U reactors. The addition of Y improves the mechanical properties and decreases Pu diffusion. Preferred compositions are (1) Mg, 0.05–4% Y; (2) Mg, 0.05–4% Y, 0.15–0.8% Zr; (3) same compositions with 0.5% Al, Be, Si, Ce and/or Mn. (NPO)

39602 IMPROVEMENTS IN FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,374,856. Aug. 31, 1964. Priority date Nov. 19, 1962, Great Britain.

Fuel elements are produced which consist of a metallic U core in a sheath of a Mg- or Zr alloy. In order to prevent diffusion of Pu through the sheath said alloys contain a constituent (Al, Pb, Bi) which can form an intermetallic compound with Pu. (NPO)

39603 METHOD OF MANUFACTURING FUEL ELEMENTS. (to Nuclear Developments Ltd.). French Patent 1,419,068. Oct. 18, 1965. Priority date Nov. 12, 1963, Great Britain.

Bars of U or U alloys are subject to superficial oxidation when stored in moist air due to the presence of UC inclusions. Oxidation also occurs in the reactor which results in severe deformation of the fuel element. These disadvantages are remedied by removal of the UC inclusions from the surface layer, either by anodizing the bar in 5% tartaric acid sol. or by heating the bar in a Br_2 atm. (NPO)

39604 OXIDATION-RESISTANT BERYLLIUM ARTICLES AND PROCESS OF MAKING. Van Thyne, Ray J.; Rausch, John J. (to U. S. Atomic Energy Commission). U. S. Patent 3,343,929. Sept. 26, 1967.

A process of protecting Be metal against oxidation by a coating of Be and Si is discussed. The coating is applied to the base metal which is then heated under reduced pressure. An inert gas at superatmospheric pressure is then introduced and the base metal is heated to the liquidus of the coating before being cooled. (AEC)

39605 METHOD FOR DEPOSITING A TUNGSTEN–RHENIUM METAL ALLOY ON A SUBSTRATE. Hamrin, Charles E. Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,343,979. Sept. 26, 1967.

A method is described for depositing a W–Re metal alloy of controlled composition on a substrate by contacting the substrate in a fluidized bed reactor with a gaseous reaction mixture consisting of WF_6, ReF_6 and stoichiometric excess of H_2 at between 400° to 550°C. (AEC)

39606 PRODUCTION OF LOW PARTICLE SIZE-HIGH SURFACE AREA METAL POWDERS. Smiley, S. H. (to U. S. Atomic Energy Commission). U. S. Patent 3,341,320. Sept. 12, 1967.

A process for forming a powder from a volatile fluoride of a metal selected from Group IIIb, IVa, Va, VIa, VIIa, and VIII of the Periodic Table is described. The process comprises the separate introduction of gas streams consisting of: a volatile metal fluoride of the metal of the selected class in a carrier selected from H_2 and F_2 and a gas selected from the non-selected carrier gas into a nozzle and surrounding annulus nozzle arrangement within a reaction zone, reacting hydrogen and fluorine to cause ignition thereof to form a hydrogen-fluorine flame, collecting the resultant powder issuing from said flame and withdrawing the resulting gases from said reaction zone. (AEC)

Properties Evaluations

Refer also to abstracts 39559, 39573, 39692, 40086, 40087, 40089, 40656, and 40732.

39607 (AD–650349) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Report No. 1, November 1, 1966–January 31, 1967. Hawthorne, J. R.; Serpan, C. Z. Jr.; Watson, H. E.; Gray, R. A. Jr. (Naval Research Lab., Washington, D. C.). Feb. 15, 1967. 45p. (NRL–MR–1753). CFSTI.

The report, covering research for the period 1 November 1966–31 January 1967, includes the following: experimental A302-B steel heats insensitive to 550F irradiation, radiation embrittlement of steels under cyclic versus constant temperature exposure conditions, effects of applied stress during irradiation on the notch ductility of A302-B steel, tensile property changes through the wall thickness of a simulated reactor pressure vessel, comparison of neutron flux values for fission versus threshold-type monitors, and equipment and procedures developed for elevated temperature remote tension testing of radioactive specimens. (auth)

39608 (AGN–8203) CORRELATION OF TENSILE AND BENDING CREEP DATA FOR HASTELLOY-X. Studt, P. L.; Baciarelli, R. (Aerojet-General Nucleonics, San Ramon, Calif.). Nov. 1966. Contract AT(04-3)-368. 42p. Dep. CFSTI.

Creep data obtained from tensile and bending tests of specimens from two heats of Hastelloy-X are analyzed to determine the degree of data comparability. The analysis indicated a systematic difference in the creep behavior of Hastelloy-X when exposed to creep bending as contrasted to creep tension loads. The experimental data showed marked differences between the creep curves generated by the two test techniques. The bending (centrifugal) curves are typical, i.e., a short primary creep stage terminating quickly in a secondary stage with a constant creep rate. The tensile creep curves show a primary creep stage having a constantly increasing creep rate followed ultimately by a secondary stage with a steady state creep rate. Due to the known difference

in stress distribution in tension and in bending and to the essential identity of other important variables such as temperature, environment, prior-to-test thermal history and heat composition, it is concluded that interaction between the creep bending stress distribution and the outer fiber microstructure are responsible for the observed differences between creep-tension data and creep-bending data. The nature of the difference is such that the creep of Hastelloy-X must be considered to depend sensitively on stress state and the microstructure of the specimens' outer layer. Specific microstructural factors causing the difference cannot be isolated with the present data. (auth)

39609 (BNWL-SA-1183) THE INFLUENCE OF THERMO-MECHANICAL TREATMENTS ON THE STRENGTH, HIGH TEMPERATURE STABILITY, AND MICROSTRUCTURE OF HASTELLOY X-280. Levy, I. S. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 10, 1967. Contract AT(45-1)-1830. 16p. (CONF-670909-3). Dep. CFSTI.

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan.

Specimens of Hastelloy X-280, a low-cobalt version of the solid-solution-hardened Ni-base alloy Hastelloy X, were given a series of thermomechanical treatments, after which they were exposed at either 540°F for 450 hrs or 1250°F for more than 1500 hrs. The specimens were then subjected to tensile and creep-rupture tests at 1350°F and to microstructural examinations. Creep-rupture tests on specimens exposed at 540°F showed that reductions in creep rates of up to a factor of 14 occurred as a result of these treatments. This strengthening resulted from dislocation networks and precipitates produced by the treatments. Tensile tests on specimens exposed at 1250°F showed a general increase in strength and decrease in uniform elongation with increasing cold work levels in the treatments. One treatment produced a 25% increase in yield strength with little loss in ductility relative to the standard treatment. Microscopy showed that this was due to dislocation tangling, which was not eliminated by the exposure, and to the precipitates developed by treatments. A comparison of the tensile data for the 540 and 1250°F exposures revealed that the 1250°F exposure produced a general increase in yield strength and decrease in uniform elongation relative to the 540°F exposure. Microscopy showed this to be due to hardening by precipitates that formed during the 1250°F exposure. Some of the thermomechanically treated specimens incurred much less strength increase and ductility loss after this exposure than did the standard-treated specimens. Microscopy revealed that this better stability was a result of extensive precipitation that formed during the treatments, which led to microstructures that were less susceptible to further precipitation during the 1250°F exposure. (auth)

39610 (COO-1198-465) THE EFFECT OF HIGH PRESSURE ON THE THERMOELECTRIC POWER AND RESISTANCE OF ALUMINUM AND GOLD. Bourassa, Ronald Ray (Illinois Univ., Urbana). June 1967. Contract AT(11-1)-1198. 88p. Dep. CFSTI.

Thesis.

The effect of pressure up to 4 kbar on the thermoelectric power of Al, Au, Ni, and Pt was determined. The change in resistance with pressure of Al and Au was also measured. Measurements were carried out at temperatures between room temperature and 1300°K or, in the case of Al, between room temperature and 900°K. A null method was used for resistance measurements and for thermoelectric power measurements, requiring an externally heated pressure vessel. The use of a special Mo alloy made this possible. High-temperature thermoelectric power data for Al are separated into terms associated with three thermally activated defects: the monovacancy, the divacancy, and the impurity-vacancy pair. Values for the formation energy and the volume were obtained for each of these defects. The effect of vacancies in gold is dominated by the effect of pressure on the lattice so that no quantitative results can be determined. An effect consistent with a monovacancy model is detected. Measurements in Pt and Ni were carried out to test the sensitivity of the method to changes in scattering mechanism. A phenomenological model is presented to explain the resistance data in Al and Au. This model gives the accepted formation volume for monovacancies in Au. It gives a value for the formation volume of monovacancies in Al in agreement with the value obtained from thermoelectric power measurements. The presence of divacancies in Al is strongly supported by this model. (auth)

39611 (EURAEC-1889) QUARTERLY REPORT NO. 9 [ON MECHANICAL PROPERTIES OF STEELS], APRIL 1, 1967-JUNE 30, 1967. (Chantiers de l'Atlantique Saint-Nazaire (France)). July 7, 1967. Contract 054-61-12RDF. 3p. (EUR-3383). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Tempering treatment results for steels of Soudotenax 44, Soudotenax 56, 1.2 MD 07, Wel Monix, and PM 24 are presented. Increased tempering treatments lowered impact strength; short tempering improved impact strength; short tempering improved impact strength. Stress relief tests for 75 to 80% were performed for steels of WSB 62, 302 B, Wel Monix, and PM 24. Stress relief curves confirm the existence, for certain number of steels, of an acceleration of the stress relief in materials in the normalized state at a temperature of 350 to 450°C. (D.C.C.)

39612 (KAPL-P-3350) WARM PRESTRESSING OF PRESSURE VESSEL STEELS. Andrews, W. R.; Baldwin, E. E.; Lordi, F. D. (Knolls Atomic Power Lab., Schenectady, N. Y.). [nd]. Contract W-31-109-eng-52. 13p. (CONF-670721-1). Dep. CFSTI.

From Irradiation Effects on Reactor Structural Materials Conference, Washington, D. C.

An investigation is in progress to determine if warm prestressing will reliably result in beneficial effects, to determine the extent of these effects and to study the mechanism involved. The material being used is Ni-Cr-Mo steel. Fatigue-cracked bend bars are being preloaded as a simple beam with the notch on the tension side. The specimens are then tested to failure via a specific load-temperature path. Some data are presented in tables and graphs. (M.C.G.)

39613 (KAPL-P-3362) FATIGUE CRACK GROWTH RATES IN UNIRRADIATED PRESSURE VESSEL STEEL. Baldwin, E. E.; Mowbray, D. F. (Knolls Atomic Power Lab., Schenectady, N. Y.). [nd]. Contract W-31-109-eng-52. 18p. (CONF-670721-2). Dep. CFSTI.

From Irradiation Effects on Reactor Structural Materials Conference, Washington, D. C.

Fatigue crack growth rate data were obtained for A302-B and A508 class 2 steels. Plate specimens containing two types of flaw geometry were tested. One type had cracks emanating from a centrally located, through the thickness, hole. The other type had a central surface crack with a semi-elliptical crack front. The tests were conducted at room temperature on load-controlled hydraulic testing machines of 120,000 to 300,000 lb capacity. Cyclic stress levels based on the gross cross-sectional area of the specimen gage section were varied from 38,000 to 67,500 psi. Data are presented in graphs. They indicate that the stress-intensity hypothesis results in an excellent correlation of the through-plate crack data. For both the A203B and the 508-2 material there was more resistance to fatigue crack growth in the thickness than in the transverse direction. (M.C.G.)

39614 (NASA-TN-D-4143) EFFECT OF RECRYSTALLIZATION ON FRICTION PROPERTIES OF SOME METALS IN SINGLE-CRYSTAL AND POLYCRYSTALLINE FORM. Buckley, Donald H. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Sept. 1967. 18p. CFSTI.

Sliding friction experiments to determine the influence of recrystallization and texturing of various metals in sliding on friction coefficients are presented. The metals examined in this investigation included Cu, Ni, Fe, W, Be, and Ti. These metals were examined in their single-crystal and polycrystalline forms. The mating surface in sliding friction experiments was polycrystalline Al_2O_3. Experiments were conducted at a sliding velocity of 0.001 centimeter per second with no external heating of the specimens. A change in release of interface frictional energy to produce recrystallization for the various metals in sliding contact with polycrystalline Al_2O_3 was achieved by changing the load. All experiments were conducted in a vacuum of 10^{-11} torr (1.33×10^{-9} N/m^2) with specimens which had been electron bombarded to clean their surfaces. At relatively modest loads recrystallization and texturing will occur for some of the highest melting point metals. W, which has a recrystallization temperature of 1200°C, recrystallized and textured at the surface with a load of 3500 grams. The process of recrystallization and texturing produces very marked changes in friction coefficients. The higher the recrystallization temperature of a metal, the higher is the load at a constant sliding velocity needed to produce recrystallization. Prior to recrystallization, all metals exhibited lower friction coefficients for single-crystal orientations than for the metals in their polycrystalline form. (auth)

39615 (NLCO-1001, pp 5.1-9) ELEVATED-TEMPERATURE TENSILE TESTS OF CAST URANIUM-BASE DILUTE BINARY ALLOYS. Wexlin, L. G. (National Lead Co. of Ohio, Cincinnati).

Cast binary uranium alloys containing as much as 1000 ppM of carbon, iron, silicon, or aluminum were tensile-tested at temperatures ranging from 885 to 1200°F. (auth)

39616 (NP-16905) METALLERS PLASTISKA DEFORMATION. FOEREDRAG VID JERNKONTORETS SYMPOSIUM DEN 26 APRIL 1966. (Plastic Deformation of Metals. The Symposia at Jernkontorets Forskning, April 26, 1966). (Jernkontorets Forskning, Stockholm (Sweden)). 1967. 120p. (In Swedish). (CONF-660457). Dep.

Ten papers presented at the conference are given. Topics covered include: dislocations and plastic deformation; microstructure and plastic deformation; influence of chemical composition on deformation hardness in austenitic stainless steels; continium theory for plastic deformation; characteristics of the deformation pattern in some industrial molding processes; high-pressure forming of powdered materials; problems in estimating the hot-workability of steel-ingots; influence of rolling temperature on grain in hot-rolled aluminum; model tests and model materials for experimental studies of plastic deformation; and deformation behavior in bulging applied to other deformation processes. (SWEDEN)

39617 (NP-16974) TUNGSTEN 25 PERCENT RHENIUM ALLOY (VACUUM ARC CAST OR POWDER METALLURGICAL PRODUCT). Technical Information. (Wah Chang Albany Corp., Albany, Oreg.). July 1967. 28p.

The properties of W-25%-Re alloy, arc-cast and powder metallurgical, are summarized for use in nuclear and aerospace applications. (J.C.W.)

39618 (ORNL-4162) MECHANICAL BEHAVIOR OF CHEMICALLY VAPOR DEPOSITED TUNGSTEN AT ELEVATED TEMPERATURES. McCoy, H. E. Jr.; Stiegler, J. O. (Oak Ridge National Lab., Tenn.). Sept. 1967. Contract W-7405-eng-26. 32p. Dep. CFSTI.

Many applications of chemically vapor deposited (CVD) W require that the material be stressed at elevated temperatures. Creep-rupture tests results at 1650 and 2200°C to evaluate the mechanical behavior of this material, and property comparisons with those of a typical heat of powder metallurgy (PM) W are presented. At 1650°C the CVD product has low fracture strains (approx 5%) and a lower minimum creep rate. At high stresses the rupture life is shorter than that of the PM material; at low stresses the rupture lives are about equivalent. At 2200°C the minimum creep rate is higher and the rupture life lower for the CVD product. Two microstructural features of importance were noted in the CVD W: the formation and growth of voids and the columnar nature of the grains. Fractographic techniques were used to study void nucleation and growth in the material. Nucleation appears to be spontaneous as the material is heated to elevated temperatures, indicating the presence of an impurity having a high vapor pressure. The growth appears to occur almost entirely by the stress-induced diffusion of vacancies into the void. At 2200°C under stress the voids reach such a large size that they comprise about 10% of the test specimen. The columnar grain structure of the material is important because it is very difficult to get extensive grain-boundary sliding and rotation in this type of structure. (auth)

39619 (ORNL-TM-1906) IN- AND EX-REACTOR STRESS-RUPTURE PROPERTIES OF HASTELLOY N TUBING. McCoy, H. E. Jr.; Weir, J. R. Jr. (Oak Ridge National Lab., Tenn.). Sept. 1967. Contract W-7405-eng-26. 27p. Dep. CFSTI.

The stress-rupture properties of two heats of Hastelloy N tubing have been determined at 760°C in- and ex-reactor. Irradiation reduced the rupture life and the rupture strain, but no effects on the creep rate were detectable. Small variations in behavior of tubular specimens tested during irradiation and small rod specimens tested after irradiation are explained on the basis of differences in stress states and sizes of test sections. The effects of irradiation are rationalized on the basis of the behavior of helium which occurs in the metal as a result of the thermal $^{10}B(n,\alpha)$ transformation. (auth)

39620 (RPI-3719-2) PRECIPITATION HARDENING OF A Mg-Th-Zr ALLOY. Mushovic, J. N.; Stoloff, N. S. (Rensselaer Polytechnic Inst., Troy, N. Y.). Aug. 18, 1967. Contract AT(30-1)-3719. 24p. (CONF-670909-4). Dep. CFSTI.

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan.

Precipitation hardening of a polycrystalline Mg-3.7% Th-0.4% Zr alloy was investigated by tensile and hardness tests and transmission electron microscopy. Peak yield strength and hardness, as measured at room temperature, were obtained by aging at 325°C for 25 minutes. Samples aged at this temperature were chosen for extensive study by transmission microscopy. For aging times ranging from 25 min to 10 hr, semicoherent transition precipitates formed as plates lying perpendicular to the basal planes and parallel to close-packed directions in the matrix. Initially the plates were ordered, with hexagonal close packed symmetry: at intermediate stages of aging long-range order disappeared as the structure moved towards a Laves phase, Mg_2Th. Finally, the equilibrium, noncoherent precipitate, of probable composition Mg_4Th, appeared. Tensile tests in the range from -196 to 180°C were carried out on material in three conditions: solution-treated, aged-to-peak-hardness (325°C, 25 min), and over-aged (325°C, 24 hrs), and the results analyzed in terms of possible dislocation mechanisms of yielding. Direct observations of samples heated in the electron beam suggest that plates of transition precipitate are sheared by dislocations moving on the basal plane. Dislocations encountering equilibrium precipitates generally avoid them by bowing. (auth)

39621 (SC-DR-67-425) RESISTANCE OF WIRE EMBEDMENTS IN SILVER-FILLED EPOXY ADHESIVES. DeLollis, N. J.; Montoya, O. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. Contract AT(29-1)-789. 12p. Dep. CFSTI.

Data are presented to show that silver-filled epoxy adhesives are stable and result in low resistance assemblies for long periods at high temperatures. The instability of certain metal combinations seems to be the principal reason for increased resistance. (auth)

39622 (SU-326P2-7) EFFECT OF POINT DEFECTS ON MECHANICAL BEHAVIOR OF CRYSTALLINE SOLIDS. Progress Report, July 1, 1966-June 30, 1967. Sherby, Oleg D.; Shepard, O. Cutler (Stanford Univ., Calif. Dept. of Materials Science). July 1, 1967. Contract AT(04-3)-326. 49p. Dep. CFSTI.

Results of an extensive study of the superplastic properties of Zn-Al alloys are presented. The eutectic alloy is shown to be superplastic and the superplasticity properties of both the eutectic and monotectoid alloys are characterized. Activation energy measurements, preferred orientation determinations, and detailed metallographic observations indicate that the process responsible for superplastic behavior occurs within the continuous zinc-rich matrix phase in both the monotectoid and eutectic alloys. An effect noted was the development of elliptically shaped cross sections as the originally round eutectic specimens were extended. This is believed to be associated with the preferred orientation, which existed in the eutectic specimens. It is believed that under suitable conditions there is an optimal range of strain rate over which a material can deform superplastically. These conditions must include a stabilized fine-grain size of the order of a few microns, and a sufficiently high temperature and appropriate strain rate for continuous recrystallization to take place. If the rate of straining exceeds the rate of recrystallization, grains elongate and necking and ultimate failure occur. Apparently at strain rates lower than the superplastic range, insufficient strain energy is introduced to result in continuous recrystallization. Experimental work was planned to investigate the predictions, at high stresses and strain rates, of some current theories of high-temperature creep. The theories predict that at the stress where the power law for creep breaks down, vacancies are generated in excess of the thermal equilibrium number. Evidence from literature studies on pure polycrystalline metals is presented to demonstrate that the breakdown of the power law for creep occurs at $\epsilon \cong 10^9 D_u$ (where ϵ is the strain rate in seconds^{-1} and D_u is the unstrained effective diffusivity), and is a generally observed phenomenon. An investigation on the influence of grain size on the Portevin-LeChatelier effect in an Al-5% Mg alloy was completed. In order to account for the dependence on grain size of the strain preceding the onset of serrations, two models were developed. These models take into account the effects of a temperature-dependent vacancy annihilation rate and modify the original Cottrell criterion for the onset of serrations. Both of these models predict the observed temperature dependence of the amount of strain preceding serrations. At relatively high temperatures, decreasing the grain size increases the strain preceding serrations, and this may be due to an increase in density of vacancy sinks. A model based on a constant rate of vacancy annihilation best describes the behavior and it is suggested that grain boundaries act as preferred nucleation sites for clustering of Mg atoms. These clusters in turn are effective as vacancy sinks. Dislocation locking was strongly enhanced in the region of strongest serrations, as evidenced by a peak in the locking force versus temperature. (auth)

39623 (TID-23953) QUARTERLY PROGRESS REPORT NO. 23 [ON STRUCTURE RESEARCH], APRIL 1, 1967-JULY 1, 1967. Grigory, Stephen C. (Southwest Research Inst., San Antonio, Tex. Dept. of Structural Research). July 19, 1967. Contract AT(11-1)-1228. 6p. Dep. CFSTI.

Two attempts were made to produce a fast fracture in the Penn State vessel with Nozzle I. The first attempt was made using a semicircular notch sharpened with a fatigue crack, the second with a notch whose length was ten times the depth. Penn State Models with Nozzles C and M are being cycled from 0 to 2500 psig to produce fatigue cracks in the notches. Crack growth data

are being obtained in studies of the effects of weld defects on the fatigue strength of A302B steel. (M.C.G.)

39624 (UCID-15193) AN ALLOY DEVELOPMENT PROGRAM FOR THE DEVELOPMENT OF MAGNETIC ALLOYS FOR A HIGH TEMPERATURE-HIGH SPEED ROTOR. Goldberg, Alfred (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 10, 1966. Contract W-7405-eng-48. 27p. Dep. CFSTI.

The development of magnetic materials for generators and high speed rotors is summarized. Existing and new alloys are considered for strength and improved magnetic properties. (J.C.W.)

39625 (UCRL-70555) SOME PROBLEMS IN THE ESTIMATION AND APPLICATION OF WEIBULL STATISTICS. Robinson, Ernest (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 1, 1967. Contract W-7405-eng-48. 74p. (CONF-670927-1). Dep. CFSTI.

From Conference of Brittle Materials, London, England.

A Weibull-type distribution is derived from slightly modified premises which explains why size effects are usually overestimated. A number of standardized forms are proposed for the Weibull distribution which enhance flexibility in application. The empirical distribution of Weibull Modulus estimators was studied using computer-generated samples with known parent population parameters. It is shown that a rather large but similar variability exists for all estimators, even the maximum likelihood, and that the coefficient of variation seems to depend only on sample size. The precision of estimate (standard deviation) improves with increasing sample size and is, roughly, proportional to $n^{-\frac{1}{2}}$ (as would be expected). The problem of fracture source distribution is solved, and an experiment on alumina beams is described which clearly demonstrates the strong influence of surface features. The experiment also provides additional information to aid in selecting the proper form of the Weibull. Application of the Weibull to strength data of composites is demonstrated, and it is shown that the composite's strength is controlled by the weakest 10 to 15% of the fibers. Therefore, the upgrading of composites is best accomplished by proof-testing of the fiber prior to fabrication. Finally, design problems being faced in large-scale application of graphite conversion machinery are described-scale up, design with arches and domes, effects of stress concentration, and fatigue studies. Some significant applications of fractography in design and diagnostics are described. (auth)

39626 (AD-652472) ACADEMY OF SCIENCES OF THE USSR. INSTITUTE OF METALLURGY. (SELECTED ARTICLES). Translated from Tr. Inst. Met. im. A. A. Baikova, Akad. Nauk SSSR, No. 2, 155-60; 208-11(1964). 15p. (FTD-MT-65-445). CFSTI.

Separate abstracts are presented for the articles discussing the effects of recrystallization annealing on mechanical properties of ternary alloys of Re with W and Mo; and procedures and results of alloying Mo, with Re for welding. (D.C.C.)

39627 CHEMICAL DIFFUSION IN THE HEXAGONAL PHASE OF THE ZIRCONIUM-PLUTONIUM SYSTEM. Lauthier, J. C.; Van Craeynest, A.; Calais, D. (CEN, Fontenay-aux-Roses, France). J. Nucl. Mater., 23: 111-14(July 1967). (In French).

The chemical diffusion coefficients were determined in dilute solutions using diffusion couples of Zr-Pu alloys (3 and 0.3 wt % Pu) and pure Zr. The concentration-penetration curves for the 3% alloy were obtained by x-microanalysis and in the 0.3% alloy by α autoradiography. The results obtained are tabulated and compared with theoretical results. It is established that Pu diffuses very slowly into the hexagonal Zr. (J.S.R.)

39628 BRAZING ALLOYS AND TECHNIQUES FOR TANTALUM HONEYCOMB STRUCTURES. Stone, L. H.; Freedman, A. H.; Mikus, E. B. (Northrop Norair, Hawthorne, Calif.). Weld. J. (N.Y.), 46: 343.s-50.s(Aug. 1967).

Brazing alloys and techniques were developed for Ta-10W, Ta-8W-2Hf, and Ta-30Nb-7.5V honeycomb structures operating at 2500 to 3500°F. High-remelt temperature as well as conventional brazing techniques were investigated. Braze alloys, containing appreciable quantities of volatile elements, which exhibit high intrinsic diffusion coefficients in Ta, produced severe Ta-10W honeycomb embrittlement during certain thermal processing and service exposures. For this reason, it was found that Ti-base brazing alloys are limited to a service temperature of approximately 2800°F. Similarly, it was established that brazing alloys for 3500°F service must contain less than 6% Ti, 6% V, or 15% Zr to eliminate honeycomb embrittlement. Nevertheless, a number of promising conventional and high-remelt brazing systems were identified for 2500 to 3800°F service. In addition, techniques were established for minimizing braze alloy/oxidation coating compatibility problems. (auth)

39629 INVESTIGATION OF THE PROCESS OF ACTIVATED SINTERING OF TUNGSTEN WITH PALLADIUM ADDITIVES. Samsonov, G. V.; Yakovlev, V. I. Porosh. Met., Akad. Nauk Ukr. SSR, No. 7, 45-9(July 1967). (In Russian).

The activated sintering of W with Pd additives was investigated. The mechanism of sintering was examined taking into account the processes occurring at the level of electronic structure of atoms. Interjection of Pd into W with a corresponding thermal excitation of atoms evoked an increase of statistical weight localized in d^5- and d^{10}-electronic configurations of W and Pd atoms correspondingly through intensification of the sintering process. With this the minimum free energy of the whole system was reached. A small additive of Pd (0.2 wt %) intensifies the process of W sintering because activation is realized by means of a peculiar chain process, in which an energetic contact appears between excited and unexcited atoms. (auth)

39630 ACTIVATED SINTERING OF TUNGSTEN AND MOLYBDENUM POWDERS. Panichkina, V. V.; Skorokhod, V. V.; Khrienko, A. F. Porosh. Met., Akad. Nauk Ukr. SSR, No. 7, 58-61(July 1967). (In Russian).

In the course of activated sintering of W and Mo powder mixture with addition of 0.5% Ni the relative density—90%—was reached during sintering at 1200° for an hour. In the course of this process the sintering was not of diffusive character, because the solid solution W-Mo was not formed. (auth)

39631 INVESTIGATION OF RADIATIVE ABILITY OF CERMET TUNGSTEN. Peletskii, V. E. Porosh. Met., Akad. Nauk Ukr. SSR, No. 7, 100-7(July 1967). (In Russian).

Integral semi-spherical degree of blackness of two samples of cermet W with different degree of surface roughness was measured by the method of electron heating. The blackness degree of the polished sample increased from 0.131 at 1200°K to 0.342 at 3400°K. For a sample, the surface of which was not subjected to the mechanical treatment after the rotationary forging, the degree of blackness increased from 0.147 at 1200°K to 0.405 at 3400°K. For polished metal the data were compared with those in the literature. (auth)

39632 MOBILITY OF TRITIUM IN SILVER AND ALUMINIUM AFTER ION BOMBARDMENT. Matzke, Hansjoachim (Technische Hochschule, Brunswick). Z. Metallk., 58: 572-5(Aug. 1967). (In German).

The release of T from Ag and Al was measured following ion bombardment using 40-keV ions and an ion dose of 4×10^{11} ions/cm^2. The observed release from both metals was essentially slower than the diffusion of H_2 as measured employing permeation or saturation/degassing experiments. The probable reason for this discrepancy is the precipitation of tritium in bubbles caused by supersaturation, even with the small T concentrations of about 10^{-5} at. % which were used. The final mass-transport through the metal is presumably due to the onset of bubble migration or to solubility of the gas and diffusion of single T atoms at increased temperatures. Annealing processes in cold worked samples do not affect the release of T from Ag to an essential degree; similarly, there is probably no essential influence on T release from Al. In contrast, the oxide films on Al are probably rate determining for the final release of T from Al. (auth)

39633 LIQUID PLUTONIUM: A REVIEW OF ITS PHYSICAL PROPERTIES. Wittenberg, L. J.; Ofte, D.; Rohr, W. G. (Monsanto Research Corp., Miamisburg, Ohio). Nucl. Appl., 3: 550-5(Sept. 1967).

The published measurements of the physical properties of liquid Pu and its alloys are reviewed. The unusually high viscosity is noted along with the low value for the heat of fusion and the volume decrease during melting. From these observations, a decrease in the metallic radius of Pu during melting is suggested. (35 references) (auth)

39634 DIFFUSION OF CARBON INTO TUNGSTEN AND MOLYBDENUM AT LOW CARBON CONCENTRATIONS. Aleksandrov, L. N.; Shchelkonogov, V. Ya. (Mordovia State Univ., Saransk, USSR). Sov. Powder Met. Metal Ceram. (Engl. Transl.), 22: 288-91(July-Aug. 1964).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR, 22: No. 4, 28-32(July-Aug. 1964).

The principal diffusion constants for C, the preexponential factor D_0, and the energy of activation of the process Q, were determined for the systems W-C and Mo-C at concentrations below that required for the formation of the carbides using ^{14}C. The effects of temperature on the annealing process were investigated, and as a result of annealing 3.5 hr in the temperature range 1100 to 1400°C, C was found to penetrate into the W and Mo to depths of 5 and 40μ, respectively. (B.L.M.)

39635 OXIDATION OF CERIUM PREPARED BY ZONAL MELTING METHOD. Kruglykh, A. A.; Pavlov, V. S.; Smirnov, Yu. N. Izv. Akad. Nauk SSSR, Metal., No. 6, 169-72(Nov.-Dec. 1966). (In Russian).

Oxidation of 99.3% pure Ce is linear in character at 150 to 300°C; at 250°C, 30 min following the initial oxidation process a non-isothermal oxidation was observed. A complete burnup of compact Ce took place at 300°C. After zonal melting, the specimens of 92.3% pure Ce oxidized at 200°C according to parabolic law and above 200°C according to linear law. The rate of linear oxidation in 92.6% Ce was calculated. Metallographic studies of the oxidation film showed that the oxidation film was denser during parabolic oxidation than during linear during which cracks and ruptures were found in both types of specimens. (R.V.J.)

39636 SOLUBILITY OF NIOBIUM IN A NICKEL–CHROMIUM SOLID SOLUTIONS. Sveshnikova, G. A.; Borzdyka, A. M. Izv. Akad. Nauk SSSR, Metal., No. 6, 137-41(Nov.-Dec. 1966). (In Russian).

Microstructural analysis of Nb solubility in Ni–Cr–Nb alloys with 20 wt % Cr showed that at 900 to 1200°C the solubility of Nb diminished 6 to 7%. The hardness of the alloy annealed at 1200°C increased linearly with an increase in Nb content. (R.V.J.)

39637 MAGNETIC PROPERTIES OF CsCl TYPE COMPOUNDS OF RARE EARTH METALS WITH CADMIUM. Alfieri, G. T.; Banks, E.; Kanematsu, K.; Choyama, T. (Polytechnic Inst. of Brooklyn). J. Phys. Soc. Jap., 23: 507-10(Sept. 1967).

Magnetization of RCd (R = Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, or Yb) has been measured between liquid-He and room temperatures. Sound specimens were obtained only by using excess amounts of R. Lattice parameters obtained from x-ray powder diffraction were in agreement with those by Iandelli. The compounds are ferromagnetic except for PrCd, SmCd, and YbCd. PrCd may be antiferromagnetic; YbCd is paramagnetic. SmCd exhibits quite peculiar behavior: diamagnetic below 110°K and paramagnetic above. Anomalies were found in the thermomagnetic curves of ferromagnetic TbCd and DyCd at 55°K and 40°K respectively. Paramagnetic moments per R calculated from the slope of $1/\chi-T$ curves are in general agreement with those of R^{+++}, except for the case of Yb. (auth)

39638 TEPLOFIZICHESKIE KHARAKTERISTIKI RAZLICHNYKH MATERIALOV TEPLONOSITELEI I METODY IKH OPREDELENIYA. (Thermophysical Characteristics of Various Heat-Transfer Agents and Their Determination Methods). Lykov, A. V.; Smol'skii, B. M. (eds.). Teplo-i Massoperenos. Tom VII. Moscow and Leningrad, Izdatel'stvo Energiya, 1966. 256p.

Twenty eight articles are included on the theory and analysis of thermophysical properties of solid and liquid metals and the relation between their thermal properties and various factors influencing them. Thermodynamics and transport properties of liquid and gaseous materials at high-temperature and pressures are discussed as well as the methods and devices for measuring heat-conductivity and specific heat of liquids and gases. (R.V.J.)

39639 AUSTENITIC STAINLESS STEEL. (to United Kingdom Atomic Energy Authority). French Patent 1,286,912. Jan. 29, 1962. Priority date Feb. 2, 1960, Great Britain.

The optimum composition of stainless steel fuel element sheaths for use in gas or vapor cooled reactors is reported. (NPO)

39640 ANALYSIS OF DATA FROM SYMPOSIUM ON HEAT-TREATED STEELS FOR ELEVATED TEMPERATURE SERVICE. Norris, E. B.; Wylie, R. D. New York, American Society of Mechanical Engineers, [1967]. 72p.

Work done on a contract of the Metals Properties Council with Southwest Research Institute to compile and report information available on the behavior of high-strength steels at high temperatures is reported. The report includes a detailed analysis of data from a symposium on heat-treated steels for high-temperature service and an appendix of tables. The tables include various properties evaluation at high temperatures. Some data are presented in figures. (B.L.M.)

Structure and Phase Studies

Refer also to abstracts 39558 and 39638.

39641 (AECL–2751) A THEORETICAL TREATMENT OF Zr–ZrO_2 EPITAXY. Ploc, R. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). July 1967. 19p. Dep. CFSTI. CAN $0.50.

The most favorable Zr/ZrO_2 (monoclinic) epitaxial relationship (based on Zr/Zr ion matching only), and the development of a large number of crystallites in the oxide film are presented. Due to the relatively low symmetry of the monoclinic (4 ZrO_2) unit cell, at least 24 different ZrO_2 crystallite orientations should exist on oxidized zirconium (0001) planes. The relative orientations of these crystallites are defined by the substrate metal symmetry. Under conditions where oxygen transport along easy paths of diffusion is rate controlling, the higher the symmetry of the substrate atom packing (parallel to the oxide/metal interface), the greater the number of possible crystallite orientations, the smaller their likely size, and the greater the expected oxidation rate. Tables of monoclinic ZrO_2 d-spacings, interplanar angles and the unit translation vectors for the cell are given. (auth)

39642 (CALT–473-21) A STUDY OF DISLOCATION MOBILITY AND DENSITY IN METALLIC CRYSTALS. Annual Summary Report No. 5 [for] Period Ending July 1967. Vreeland, T. Jr.; Wood, David S. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Aug. 1967. Contract AT(04-3)-473. 11p. Dep. CFSTI.

Refinements in the application of the Berg-Barrett x-ray method to the observation of individual dislocations in metallic crystals were made and applied to dislocation studies. Basal dislocation velocities in Zn were measured as a function of applied shear stress and the velocity-controlling mechanisms were studied. Studies on the dislocation velocity and slip on the $\{\bar{1}2\bar{1}2\}\langle\bar{1}2\bar{1}3\rangle$ systems of Zn were completed. Pyramidal slip at temperatures below about 110°K was thermally activated. The temperature dependence of dislocation mobility in Cu is being studied. Mechanisms governing dislocation mobility in Al are also being investigated. Samples are being prepared for studies of the effects of carbon on dislocation mobility in Si–Fe systems. (M.C.G.)

39643 (COO–1417-3) EXPERIMENTAL STUDY OF THE SURFACE STRUCTURE AND ELECTRONIC PROPERTIES OF SINGLE CRYSTAL MOLYBDENUM AND TUNGSTEN RIBBONS. Progress Report, November 1, 1966–August 1, 1967. Morgan, Donald R.; Blass, William E. (Saint Mary's Coll., Winona, Minn.). Aug. 7, 1967. Contract AT(11-1)-1417. 13p. Dep. CFSTI.

Further improvements in methods for preparation of Mo and W single crystals were made. Cutting of the crystals by electric-discharge machining and refining of grinding and polishing procedures considerably improved the size and quality of the crystals. The LEED (low-energy electron diffraction) system was modified by an improved set of Helmholtz coils, which reduce the earth's magnetic field in the diffraction chamber to 10^{-3} gauss so that low-voltage electrons are essentially undeflected in the chamber. The system now works consistently with a range of electron energies from 20 to 750 eV available. Studies of crystal cleaning were carried out on a (110) Mo crystal ribbon and a (100) Mo ribbon. LEED patterns were obtainable from nonelectropolished Mo crystals. The (110) surface of Mo appeared to be highly stable relative to contamination since at pressures of $\sim 5 \times 10^{-10}$ torr, patterns remained on the surface for several hundred hours after 1900°C cleanings while the (100) surface sustained a LEED pattern for approximately 15 hr after 1900°C cleanings. Some difficulty was experienced with the vacuum system used for the retarding potential experiment. The vacuum chamber was modified and the internal structure for these experiments completed. (M.C.G.)

39644 (NUMEC–3428-35) GROWTH OF SINGLE CRYSTALS OF PLUTONIUM. Progress Report, April 1, 1967–June 30, 1967. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Aug. 1967. Contract AT(30-1)-3428. 17p. Dep. CFSTI.

A series of strain-anneal experiments has been conducted using a δ-stabilized Pu-1.22 w/o Ga alloy. The critical strain for this material was determined to be within the region between 1.50 and 1.75% strain, as extremely large grains (5.7 mm × 3.0 mm) had grown in the specimen that received a 1.75% strain, as contrasted with only a minor increase in grain size in the specimen strained 1.50%. Metallographic examination and x-ray back-reflection Laue patterns confirmed the presence of large grains, free of substructure, in the specimen which received a 1.75% strain. (auth)

39645 (ORNL–TM–1888) FORMATION AND CHARACTERIZATION OF THE A 15-TYPE STRUCTURE IN CHEMICAL VAPOR DEPOSITED TUNGSTEN–RHENIUM ALLOYS. Federer, John Irvin (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 49p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

An A15-type phase was identified in vapor-deposited W–Re alloys by x-ray and neutron diffraction, metallography, and hardness measurements. The crystal structure was established as an A15 type by comparing experimental x-ray and neutron diffraction integrated intensities with calculated intensities based on the usual atomic arrangement for A15-type phases. The composition range for the existence of this phase varied with temperature, but was near W_3Re; in the temperature range investigated, 1000 to 1500°C, the phase occurred alone or coexisted with the tungsten-rich terminal solid solution (β phase) or with σ phase. The phase was about four times harder than the β phase, possibly limiting the usefulness of alloys containing the A15 phase as a major con-

stituent. Transformation to β or to $\beta + \sigma$ phases during long-time anneals at deposition temperatures showed that the phase was metastable. Electron microprobe analyses revealed no substantial difference in composition between coexisting β and A15 phases. In addition, the lattice parameter of the A15 phase, whether occurring alone or coexisting with β or σ, varied linearly with alloy composition. The metastable nature, compositional similarity with β, and continuous variation in lattice parameter show that the formation of the A15 phase is characteristic of the vapor-deposition process. Based on a proposed reason for formation during deposition, the A15 phase would not be expected to form in β- or β-plus-σ phase alloys subjected to service at elevated temperatures. (auth)

39646 (RPI-1044-13) ANISOTROPIC DIFFUSION AND ELECTROMIGRATION. Annual Report. Huntington, H. B. (Rensselaer Polytechnic Inst., Troy, N. Y.). Aug. 1967. Contract AT(30-1)-1044. 9p. Dep. CFSTI.

Electromigration studies on U, Zr, Ag, Zn, and Na-K liquid alloys are continuing. A series of runs were made to measure the effects of Ag on Zn self-diffusion. A computer program has been developed to explore the distribution of kinetic energy between the various atoms participating in the decomposition normal mode at the saddle point configuration, the determination of the average amount of energy localized on the jumping atom at the start of the jump, and the fraction of energy fed into the moving atom from the charge carrier flow that remains with the atom to the saddle point. (J.C.W.)

39647 (UCRL-50264) A REVISED PROGRAM FOR CALCULATING X-RAY POWDER DIFFRACTION PATTERNS. Smith, Deane K. (California Univ., Livermore. Lawrence Radiation Lab.). June 12, 1967. Contract W-7405-eng-48. 101p. Dep. CFSTI.

A revision was made of the FORTRAN program for calculating x-ray powder diffraction patterns previously described (UCRL-7196). This version simplifies the input by using a file tape containing the form-factor curves, the space-group symmetry positions, and absorption curves. It also prepares the output data in a form easily utilized by other routines. This version also allows more atoms and f tables to be used. A routine, XCHART, was written to simulate a diffractometer chart. Gaussian or Cauchy profiles are used, with individual profiles being plotted for α_1 and α_2. Overlap of profiles is accomplished by summing the individual profiles. The variation of half-width as a function of diffraction angle is determined from empirical curves. An additional routine, UPDATE, is described, which will allow new form factors and space group symmetry sets to be added to the file tape. (auth)

39648 ZIRCONIUM-TANTALUM-CHROMIUM SYSTEM. Gebhardt, Erich; Rexer, Juergen; Petzow, Guenter (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk., 58: 534-41(Aug. 1967). (In German).

The system Zr-Ta-Cr was established by metallographical, thermal, chemical, and x-ray examinations. The planes of primary crystallisation, the course of the univariant, and the position of the nonvariant equilibria were determined. Also, isothermal sections at 1700, 1500, and 1300°C were worked out. Thus a good representation of the temperature and concentration dependence of the special constitution was achieved. Three four-phase reactions, in which the phase (Zr, Ta)Cr_2 is involved, were found at 1580, 1550, and 1450°C. Both modifications of the phases $ZrCr_2$ and $TaCr_2$ formed a continous series of solid solutions, which can be represented in a quasi-binary system. The β-solid solution in the binary system Zr-Ta occurring at temperatures above 1780°C could not be stabilized by Cr additions. The ternary equilibrium, melt + β_1 + β_2, resulting from decomposition of β in β_1 and β_2 was confirmed. Since, in the ternary system, the mutual solubilities of the components are lower than in the binary systems, the phase diagram in consideration is dominated by large heterogeneous zones. (auth)

39649 SOLUBILITY OF TUNGSTEN IN COBALT IN SOLID PHASE. Larikov, L. N.; Shmatko, O. A. (Inst. of Metal Physics, Kiev). Dopov. Akad. Nauk Urk. RSR, Ser. A, No. 6, 540-2(1967). (In Russian).

By x-ray dilatometric and metallographic methods the solubility of W in Co in the solid phase was investigated. The curve of W solubility in Co was compared to existing diagrams of Co-W. (auth)

39650 STRUCTURE STUDIES OF THE Mg-3 PERCENT Nd ALLOY FOLLOWING HIGH-TEMPERATURE PLASTIC DEFORMATION. Rokhlin, L. L.; Oreshkina, A. A. (Baikov Inst. of Metallurgy, Moscow). Fiz. Metal. Metalloved., 22: 420-3 (Sept. 1966). (In Russian).

Mechanical properties of Mg-3% Nd alloy at room temperature and after tempering from 535° in water and aging (at 200° for 8 hr) are tabulated. The microstructure of the specimen was studied at 260, 300, 360, and 420°C. (R.V.J.)

39651 X-RAY STRUCTURAL ANALYSIS OF Nb-Ni-Al ALLOY. Markiv, V. Ya.; Matushevskaya, N. F.; Kuz'ma, Yu. B. Izv. Akad. Nauk SSSR, Metal., No. 6, 127-33(Nov.-Dec. 1966). (In Russian).

X-ray structural analysis of the Nb-Ni and Nb-Ni-Al alloys showed that at 900°C nickel dissolved up to 11 at. % Nb. The Nb-Ni alloy has a homogeneous region of 50 to 60 at. % Nb and is in equilibrium with solid solutions of nickel and niobium. Constitution diagrams were constructed for the phase equilibriums at 900°C and for aluminum-rich alloys at 800°C. (R.V.J.)

39652 CONSTITUTION DIAGRAM OF A TERNARY W-Mo-Ti ALLOY. Zakharov, A. M.; Savitskii, E. M. Izv. Akad. Nauk SSSR, Metal., No. 6, 121-6(Nov.-Dec. 1966). (In Russian).

Microscopic, phase, and x-ray analyses were made of the melting temperature and microstructure of the ternary W-Mo-Ti alloy. The polythermal cross sections were constructed for the W : Ti ratios 4 : 1 and 3 : 2 and a constant Mo content of 10 and 30 wt %. The constitution diagrams and isothermal cross sections were constructed for the W-Mo-Ti alloys at 1500 and 1000°C. Additions of Mo to the W-Ti alloy increased the limited solubility of the components in the solid state to the point of complete diffusion. Continuous solid solution series of tungsten and titanium were formed at 1500°C and 20 wt % Mo content and at 1000°C with Mo content of 25 wt %. (R.V.J.)

Radiation Effects

Refer also to abstracts 39701 and 40719.

39653 (AD-650103) GENERALIZED MODEL FOR SEMICONDUCTOR RADIATION RESPONSE PREDICTION. Quarterly Report No. 7, September 15-December 14, 1966. Raymond, James P.; Johnson, Robert E. (Nortronics, Newbury Park, Calif. Applied Research Dept.). Mar. 1967. Contract DA-28-043-AMC-00423(E). 79p. (NARD-67-2-R; ECOM-00423-7). CFSTI.

Electrical and ionizing radiation experiments were performed on junction isolated monolithic integrated transistor and resistor elements and comparisons are presented between their measured and calculated junction areas and electrical and ionizing radiation response. The electrical lumped-model representation of a junction field effect transistor was developed. The bipolar transistor model was increased in detail so that the following parameters are now variable: collector depletion layer width, collector lifetime, and emitter and collector junction capacitance. A sophisticated numerical integration routine for solving lumped model equations is presented. A test fixture designed to minimize parasitic radiation response is described. (auth)

39654 (AD-651144) RADIATION EFFECTS ON THIN-FILM INTEGRATED CIRCUIT ELEMENTS. Quarterly Report No. 1, October 15, 1966-January 14, 1967. Report No. 6, C7-420/501. Strahan, V. H.; Krueger, A. F. (Autonetics, Anaheim, Calif.). Apr. 24, 1967. Contract DA-28-043-AMC-02431(E). 54p. (ECOM-02431-1). CFSTI.

The efforts of this quarter were directed toward a review of the past work on this program with the objective of uncovering areas of data and information which may have been missed or not fully exploited. The general features of all previous data were reviewed. The overall wave shapes of the signals were tabulated from both the electrode and counter electrode of each capacitor studied. These tabulations were made for irradiation in air and in vacuum at Vo = +40, 0, and -40 volts. To gain further information about secondary emission replacement currents, plots of the V delta 1 + V delta 2 versus Vo data were prepared for as many as possible of the previously studied capacitors. These plots represent the net replacement current which occurs in the capacitor during irradiation. (auth) (TAB)

39655 (AERE-M-1899) STRESS CORROSION OF IRRADIATED TYPE 316 STAINLESS STEEL. (An Addendum to AERE-R-5014). Knights, C. F. (Atomic Energy Research Establishment, Harwell (England)). June 1967. 8p. Dep. CFSTI. UK 1s. 9d.

Investigation of the effect of irradiation with mixed thermal and fast neutrons on the susceptibility of Type-316 stainless steel to stress corrosion cracking in $MgCl_2$ solution was extended to stresses below 5,000 lb/in.^{2}. There is a critical applied stress below which the time to failure is very dependent on stress. Fast neutron damage to the metal appears to be responsible for the enhanced susceptibility to stress corrosion cracking. (auth) (UK)

39656 (BNWL-463) RADIATION-ENHANCED OXIDATION OF ZIRCALOY-2 IN pH-10 LiOH AND pH-10 NH_4OH. Johnson,

A. B. Jr.; Irvin, J. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1967. Contract AT(45-1)-1830. 49p. Dep. CFSTI.

Pronounced neutron-flux-induced oxidation occurred on all Zircaloy-2 specimens exposed at 280°C in pH 10 LiOH. Rates up to 3 mg/dm^2 day were observed. A linear relation was observed between in-flux weight gain and fast neutron fluence. Marked differences in susceptibility to flux-induced oxidation and hydriding occurred for the three Zircaloy-2 lots. The highest oxidation rate was accompanied by the lowest rate of H_2 absorption. G-7 loop specimens transferred from pH 10 LiOH to pH 10 NH_4OH continued to oxidize at rates characteristic of the lithiated system. However, the transfer caused more H_2 absorption than that predicted from trends established in the lithiated system. (M.C.G.)

39657 (GEAP-5516) SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM. Quarterly Progress Report No. 17. Klepfer, H. H.; Busboom, H. J.; Pickett, E. A.; Rooney, D. M.; Blood, R. E. (General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.). July 1967. Contract AT(04-3)-189. 14p. (EURAEC-1901). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

A Zr + 2.0 at. % Cr + 0.16 at. % Fe alloy (Zr-Cr) were evaluated as nuclear fuel cladding. Alloy-clad fuel rods were irradiated in the Consumers Big Rock Point Reactor. The fuel irradiation was delayed by a variable corrosion performance of the first full-scale vendor batch of alloy tubing and bar stock. The difference between the variable performance by material from the large vendor ingot and the reproducibly excellent performance in the same tests by material from small laboratory melts was caused by nonuniform distribution of coarse intermetallic compounds in the vendor material. Laboratory studies have resulted in a proposed process for ensuring fine uniform intermetallics under vendor conditions. Both fuel rods and dummy rod containing precut corrosion and tensile samples were fabricated and shipped to Consumers. These rods were loaded into a reload fuel bundle designated B1 and loaded into the core during the May-June shutdown. Total exposure to date is ~300 MWd/T U average. Characterization of vendor tubing and rod continued to show that the potential of the Zr-Cr alloy was realized on the second round of vendor materials. A brief description of fabrication history for the second round of vendor material is presented. (auth)

39658 (N-67-17985) PHOTOVOLTAIC EFFECT AND UTILIZATION OF CELLS. Semiannual Report, July 1-December 31, 1966. Loferski, J. J.; Kasai, I.; Giriat, W. (Brown Univ., Providence, R. I. Div. of Engineering). 26p. (NASA-CR-81664; SAR-3). CFSTI.

The effects of 115 keV electron irradiation (this energy is below the threshold for bulk damage) on the surface recombination velocity s of n- and p-Si of various resistivities are determined from studies of changes in the photovoltaic short circuit current I_{sc} resulting from strongly absorbed light. The cells were special solar cells made on various resistivity base material. Both the "diffused" face and the "base" face were subjected to irradiation. It was found that as a result of irradiation, the value of s for n-Si generally decreases while that of p-Si generally increases. The changes can be as large as factors of 4, but are more commonly of the order of 10 to 20%. The recovery of the pre-irradiation state is also described and discussed. A new apparatus for conducting experiments in an organic vapor free vacuum is also described. (auth)

39659 (NP-16837) ETUDE AU MOYEN DU TRAINAGE MAGNETIQUE DE DIFFUSION DES DEFAUTS CREES PAR IRRADIATION DANS LE FER. (Study by Means of Magnetic Ordering of Diffusion of Defects Created by Irradiation of Iron). Moser, Pierre (Grenoble Univ. (France)). [1965]. 183p. (In French). DTIE.

Thesis.

The diffusion magnetic ordering of defects created by irradiation was studied in Fe. The nature of the different point faults is reviewed. The principles of magnetic orderings are given. Methods used to create the point defects and to study them are described. Point defects in Fe are divided into five principal groups; each of these was studied in succession and results of the measurement of the magnetic ordering and of auxillary experiments are given. The diffusion magnetic ordering method was found to be very advantageous as data can be obtained simultaneously on dosimetry, reorintation, and recovery of the faults examined. With this method extremely low concentrations of faults can be detected. (J.S.R.)

39660 (WAPD-TM-629) IRRADIATION BEHAVIOR OF ZIRCALOY-CLAD FUEL RODS CONTAINING DISHED-END UO_2 PELLETS (LWB-LSBR DEVELOPMENT PROGRAM). Berman, R. M.; Meleran, H. B.; Patterson, P. W. (Bettis Atomic Power Lab., Pittsburgh, Pa.). July 1967. Contract AT(11-1)-Gen-14. 118p. Dep. CFSTI.

Two fuel rods, BETT 79-21 and BETT 79-25, containing cylindrical UO_2 pellets with dished ends were irradiated in the B-4 Loop of the Materials Test Reactor to a depletion of 12.41 and 15.26×10^{20} fissions/cc, respectively. Rod 79-21 was irradiated for nine days in the failed condition prior to removal; it showed extensive circumferential ridging of the clad at the interfaces between pellets, as well as hydriding, cracking, and spalling of the clad. Rod 79-25 was removed before failure when it also showed circumferential ridging of the clad. Approximately 35% of the total fuel swelling of a typical pellet was accommodated in the dishes; 49% more was accommodated in filling the internal porosity of the fuel material. The remaining 16% of the total swelling (combined with thermal expansion) is postulated to have caused the expansion of the diameter and ridging that led to failure. Total rate for all three types of fuel swelling was 0.82 v/o per 10^{20} fission/cc at the conditions under which these samples were irradiated. (auth)

39661 MEASUREMENT OF ENERGY LIBERATED IN THE COURSE OF ANNEALING SAMPLES OF BERYLLIUM IRRADIATED BY NEUTRONS AT 77°K. Bonjour, Emmanuel; Nicoud, Jean-Claude; Delaplace, Jean (Centre d'Etudes Nucleaires, Grenoble, France). Compt. Rend., Ser. C, 264: 2113-14(June 26, 1967). (In French).

Measurements on energy liberated during the course of the annealing of Be samples irradiated by neutrons at 77°K showed three stages of restoration: from 85 to 145°K (stage II), from 145 to 210°K (stage III), from 210 to 320°K (stage IV). Hypotheses are considered for the interpretation of stage IV. (tr-auth)

39662 EQUILIBRIUM POTENTIALS OF ISOLATED METAL AREAS DURING ELECTRON BEAM BOMBARDMENT POLYMERIZATION. Geddes, K. R. (James Ferguson and Sons, Ltd., London). Microelectron. Rel., 6: 17-25(Feb. 1967).

The value of equilibrium potential reached by an isolated metal thin film under electron bombardment was examined as the accelerating voltage of the electron gun was varied between about 100 and 500 V. Measurements were taken with and without grounding the film between readings. The effects on the equilibrium potential of variations in the past history of the metal film, thickness of polymer coating, partial pressure of organic monomer, and electron beam current were investigated. The use of monitor strips of materials different from, or having a different past history from, the target metal was investigated. A qualitative explanation of the results is suggested, and the implications with regard to thin film device fabrication are discussed and illustrated. (BBB)

39663 SPECIMEN THINNING BY ION BOMBARDMENT DURING DIRECT OBSERVATION AT 1 MILLION VOLT ELECTRON MICROSCOPY. Vingsbo, Olof; Lasserre, Armand (Laboratoire d'Optique Electronique, Toulouse). J. Microscop., 5: 527-36(1966).

The effect of Ar ion bombardment on thin sections (1000 Å) of austenitic stainless steel (18% Cr, 10% Ni) was followed by electron microscopy at 1-MeV. The stainless steel investigated had a lattice parameter of ~3.5 Å. The initial crystal thicknesses corresponded to 3000 to 4000 close-packed atomic planes, and the thinning was performed until some 500 planes remained. It was possible to follow in image sequences how the removal of successive crystal layers caused the dislocation lines to shorten from one side. More regular dislocation configurations, such as networks and pile ups, were also studied. A general observation was that, except for fractions situated in the removed layer, dislocations hardly ever vanished or rearranged during the thinning. Even boundaries and twin boundaries were found to be stable during the thinning procedure. No influence of ion bombardment or thickness decrease could be detected. The investigated structure of common lattice defects in thin foils was found to be representative of that in much thicker foils. It was concluded that no crystal damage was caused by ion bombardment. As electropolishing at ordinary conditions probably is less violent, it seemed that electrolytic thinning does not affect the structure of crystal defects. The possibility that 3-dimensional analysis of lattice defects offers a method for experimental testing of some predictions of the dynamic theory of image contrast in electron microscopy is suggested. (BBB)

39664 SMALL VACANCY DISLOCATION LOOPS IN NEUTRON-IRRADIATED COPPER. Ruhle, M.; Wilkens, M. Phil. Mag., 15: 1075-8(May 1967).

The question of the nature of the black dots observed in neutron-irradiated Cu by transmission electron microscopy is reconsidered emphasizing the results obtained by measuring the depth

positions of the defects in the foils by quantitative stereo microscopy. The discrepancies between the authors' results and those recently obtained by McIntyre (1967) are critically discussed. The previous conclusion that the defects observed in the authors' work are of vacancy type is upheld. (auth) (UK)

39665 CORRELATION OF RADIATION DAMAGE TO STEEL WITH NEUTRON SPECTRUM. Sheely, W. F. (Atomic Energy Commission, Washington, D. C.). Nucl. Sci. Eng., 29: 165-75 (Aug. 1967).

Expressions were developed for the rate of production of atomic displacments in iron by neutron spectra found in reactors. Factors considered include anisotropic, elastic high-energy neutron scattering, inelastic high-energy neutron scattering, thermal-neutron capture-gamma recoil-induced displacements, and energy loss by electron excitation. An evaluation of calculated atomic displacement density as a measure of radiation damage to steel was made by determining if this approach could rationalize the differences in damage rate produced by different reactor spectra. It was found that available data on radioinduced property changes could be satisfactorily normalized to a common basis by expressing exposure as displacement density when all the above-mentioned factors are given consideration. (auth)

39666 DEFORMATION OF NEUTRON-IRRADIATED COPPER SINGLE CRYSTALS. Sharp, J. V. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag., 16: 77-96(July 1967). (AERE-R-5327).

The deformation of neutron-irradiated Cu single crystals was studied by transmission electron microscopy techniques. The width of the defect-free channels formed by the passage of dislocations was measured as a function of temperature, dose and strain, in sections cut normal to the primary glide plane. The width and spacing of the channels were also compared with surface replicas. Sections parallel to the primary glide plane were examined to provide details of the dislocation structure within a channel. The formation and development of the channels are discussed and the destruction of loops by dislocations is examined. The deformed state of neutron-irradiated crystals is compared with that of unirradiated crystals. (auth) (UK)

Ceramics and Cermets

Preparation and Fabrication

Refer also to abstracts 39556, 39558, 39559, and 40715.

39667 (AD-650508) ADVANCED CERAMIC SYSTEMS FOR ROCKET NOZZLE APPLICATIONS. Quarterly Report No. 1, November 1, 1966-February 28, 1967. Miccioli, Bruno R. (Carborundum Co., Niagara Falls, N. Y. Research and Development Div.). Mar. 15, 1967. Contract N00017-67-C-2406. 11p. CFSTI.

The possibilities for mating refractory carbides with Carb-I-Tex are being investigated. Composite structures, suitable for evaluation by sub-scale motor firings, are being fabricated. The carbide-graphite composite system has been applied to a pilot ejection catapult nozzle requiring both high mechanical shock and thermal shock resistance. Three nozzles have been submitted for testing. The thermal shock tests conducted by TRW, Inc., are reported. Although limited, these indicate resistance tendencies as a function of composition. (auth) (TAB)

39668 (AI-CE-73) HEAVY WATER ORGANIC COOLED REACTOR. THE PREPARATION OF URANIUM CARBIDE FROM ECONOMICAL URANIUM COMPOUNDS. Hanson, L. A. (Atomics International, Canoga Park, Calif. Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.). Aug. 15, 1967. Contract AT(38-1)-430. 34p. Dep. CFSTI.

The preparation of uranium carbide (UC) from uranium tetrafluoride, ammonium diuranate (ADU), and uranium trioxide (UO_3) was studied on a gram scale to establish basic process parameters for economic comparison with the conventional UO_2 to UC fabrication method. The process developed in each case involved compacting blended powders (which were, respectively, UF_4-SiO_2-C, $(NH_4)_2U_2O_7-SiO_2-C$, and UO_3-C) and heating in vacuum in stages to convert the uranium compound to UO_2 at temperatures up to 850°C and carbothermically reduce the resulting UO_2 to UC at temperatures above 1300°C. The SiO_2 was used in the ADU conversion to remove a fluorine contaminant without uranium loss. Uranium carbide of controlled carbon content and low oxygen content was produced from each of these compounds. Uranium carbide was prepared from ADU in 20-kg quantities to demonstrate production scale-up of one of the processes studied. The UC produced was of equivalent or better quality than that produced from UO_2 under similar conditions. An economic comparison indicated that there are potential savings in using each of these materials, depending on the uranium source, instead of UO_2 for UC production. Quantitative evaluation of experimental results and overall economics indicates that only marginal savings may be gained by using ADU and UO_3; but a cost reduction is expected using UF_4. (auth)

39669 (KFK-555) DIE ABSCHEIDUNG VON MOLYBDAEN AUF ZrO_2- UND UO_2-KUGELN AUS DER GASPHASE. (The Deposition of Molybdenum on ZrO_2 and UO_2 Spheres From the Gas Phase). Schneider, H.; Schoenwald, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Jan. 1967. 22p. (In German). Dep.

The deposition of metallic Mo from the gas phase by reduction of molybdenum pentachloride was proposed for the coating of UO_2 spheres. In the course of research with zirconium oxide it was established that $MoCl_5$ not supplied in ampules is very strongly contaminated with oxygen,and must be freshly sublimed before each research series. The method was then tested on zirconium oxide spheres in small charges, in which up to 25 wt % Mo was prepared and then transferred to UO_2 spheres. Up to 21 wt % Mo with filler masses of 100-g UO_2 was evaporated. The techniques were so improved that 100-g UO_2 charges could be coated with pure Mo layers with safety and good yields. The surface properties of the deposited Mo were evaluated visually with a microscope and its purity was detected with chemical and x-ray methods. The parameters of layer quality and yield are discussed with special consideration of the evaporation and gas velocities. (tr-auth)

39670 (NP-16745) COMBUSTIBLES CERAMICOS DE DIOXIDO DE URANIO PARAREACTORES NUCLEARES EN MEXICO. (Uranium Dioxide Ceramic Fuels for Nuclear Reactors in Mexico). Castillo Molina, Josue (Instituto Politecnico Nacional, Mexico City. Escuela Superior de Ingenieria Quimica e Industrias Extractivas). 1966. 112p. (In Spanish). Dep.

Thesis.

The fabrication of UO_2 tablets for nuclear reactors was studied. Each of the steps in the fabrication, beginning with UO_2, was investigated in detail and the variables in different steps were analyzed to determine their effect on the final product. A procedure for the fabrication of satisfactory tablets was proposed. (J.S.R.)

39671 (UJV-1805) OTAZKY PRIPRAVY JADERNYCH KERAMICKYCH MATERIALU NA MOKRE CESTE. (Preparation of Nuclear Fuel by Wet Process). Baran, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Apr. 1967. 36p. (In Czech). Dep.

The literature is reviewed on wet-process methods (e.g., Excer, sol-gel) for making uranium (and thorium) preparations. The reduction of U(VI) to U(IV) by electrolytic processes, with H_2, formic acid, or hydrazine with a catalyst, and by photoactivity are discussed. UO_2 is an intermediate in the preparation of UC, U, USi_2, and UF_6 as well as being a fuel material itself. The dry and wet methods are compared, e.g., the wet processes can be carried out at lower temperatures and with less risk of forming radioactive aerosols. (89 references) (TTT)

39672 (UCRL-Trans-10112) PROCESS FOR BONDING CERAMIC OBJECTS WITH ONE ANOTHER OR WITH METAL OBJECTS. Bol, Arie; Klaassen, Christiaan Alfons Maria. Translated by Z. F. St. Gallay for Univ. of California, Lawrence Radiation Lab., Livermore, from Dutch Patent 83,997. 16p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

A variety of ceramics, such as porcelain, steatite, TiO_2, SiC, ferrites, and magnetic iron compounds, are bonded by applying between the objects a mixture of finely divided Cu and Ag, either in the metallic state or as oxides, and heating to over 945°C in a non-reducing atmosphere. (P.G.C.)

39673 SLIP CASTING OF NIOBIUM CARBIDE POWDERS. Dobrovol'skii, A. G.; Palfalvi, A. Yu.; Zyuz, A. P. Porosh. Met., Akad. Nauk Ukr. SSR, No. 7, 29-36(July 1967). (In Russian).

A method for slip casting parts from NbC powder with the application of 1% aqueous solution of polyvinyl alcohol with addition of 3 to 5% ethyl alcohol as a dispersive medium was studied. Fine powder ground by the planetary mill was used as a dispersive phase. The effects of dispersive phase content, slip pH, and temperature of casting on the properties of mouldings are outlined. A high compactness of raw moldings (5 g/cm^3) was observed. The porosity of samples sintered for an hour at 1700 to 1800°C was measured at 15.5%. (auth)

39674 METALS AND ALLOYS WITH INCLUSIONS OF DISPERSED IMPURITIES OF HIGH MELTING COMPOUNDS AND FIBERS. Mozzhukhin, E. I. pp 114-56 of Metallurgiya

Tsvetnykh i Redkikh Metallov, 1965. Ageev, N. V. (ed.). Moscow, Institut Nauchnoi Informatsii, 1966. (In Russian).

A review is given on the development of metals and alloys hardened by dispersion materials included by internal oxidation, selective reduction of salts and metal oxides, metal coating, mechanical mixture of matrix metal powder and dispersion oxides, and by sputtering liquid metal solution. Metallographic studies indicated that small additions of ThO_2, ZrO_2, HfO_2, Al_2O_3, and UO_2 into W during sintering in a vacuum are stable at 2600 to 2800°C but TiN, ZrN, HfN, TaN, HfC, TaC, and Ta_2C are unstable at these temperatures. Dispersion inclusions into nuclear fuel strengthened the matrix and reduced distention caused by gas bubbles containing Kr and Xe decay products. Inclusions of UO_2 distributed evenly in Be, Mg, Zr, Nb, Ti, Ni, V, Mo, and Si. PuO_2 was used in Mo, Nb, Ta, and V. Addition of TiO_2 accelerated sintering of tungsten and molybdenum containing UO_2. Reinforcement of Ti and Al by stainless steel and Mo fibers is discussed. (143 references). (R.V.J.)

39675 THE THERMAL CONDUCTIVITY OF GRAPHITE PARALLEL TO THE BASAL PLANES AND THE VELOCITY OF PHONONS IN THE "OUT-OF-PLANE" ACOUSTIC MODE. Kelly, B. T. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Phil. Mag., 15: 1005-9(May 1967). (TRG-Report-1313).

The thermal conductivity of polycrystalline graphites and pyrolytic graphite parallel to the basal planes varies as some power of the temperature between 2.3 and 2.8 between 10°K and 80°K. The conductivity in this temperature range is dominated by the phonon contribution and is believed to be limited by crystallite boundary scattering. In the same temperature range the specific heat is observed to vary as ^2T and thus the behaviour of the conductivity has been held to be anomalous. A calculation of the mean phonon velocity parallel to the basal planes for the "out-of-plane" acoustic mode, as a function of temperature, using Komatsu's model of the lattice dynamics of graphite, shows that at least part of this temperature dependence can be accounted for. (auth) (UK)

39676 METHOD OF BONDING A METALLIC CARBIDE TO A METAL BASE. (to U.S. Atomic Energy Commission). French Patent 1,271,091. July 31, 1961. Priority date Nov. 12, 1959, United States.

Bonding of a UC–ZrC solid solution compound to a Nb or Ta base is achieved by first converting the surface of the base with graphite powder at 2000–2200°C to NbC or TaC and then bonding the (U, Zr)C powder to the thus treated surface at 1700–2200°C and 350 kg/cm^2 pressure. A binder and sintering promoter is eliminated during the heat treatment. The composite obtained finds application as an emitter in nuclear thermionic cells. (NPO)

39677 METHOD OF PREPARING NUCLEAR CARBIDE FUELS. (to EURATOM). French Patent 1,434,775. Feb. 28, 1966. Priority date Sept. 1, 1964, Belgium.

UC is prepared by one of the following reactions: $3UF_4 + Al_4C_3 \rightarrow 3UC + 4\ AlF_3$ or $3UF_4 + 4Al + 3C \rightarrow 3UC + 4AlF_3$. The powdered primary materials are formed into pellets and heated in vacuum up to 1600°C to yield a sintered UC compact free from Al and AlF_3. (NPO)

39678 METHOD OF COATING URANIUM CARBIDE WITH NIOBIUM AND FUEL ELEMENTS FOR NUCLEAR REACTORS. (to EURATOM). French Patent 1,344,775. Oct. 21, 1963. Priority date Jan. 24, 1962, Germany.

A U-carbide body is thoroughly cleaned by ionic discharge in vacuum, coated with 20 μ Cu and then with 0.1–30 μ Nb by vaporization in vacuum and finally heated at 400–650°C. The Nb layer acts as diffusion barrier when the body is inserted in a metal can. (NPO)

39679 IMPROVEMENTS IN PROCESSES INVOLVING THERMAL CONTRACTION OF MATERIALS. (to General Electric Co. Ltd.). French Patent 1,306,206. Sept. 3, 1962. Priority date Sept. 30, 1960, Great Britain.

In the manufacture of graphite tubes, useful as fuel element cans, from a dispersion of cellulosic materials by casting, drying, and carbonizing, undesirable contractions during the heat treatments are prevented through the application of suitable mandrels. (NPO)

39680 METHOD AND APPARATUS FOR THE PRODUCTION OF NUCLEAR FUEL. (to General Electric Co.). French Patent 1,331,805. May 27, 1963. Priority date Sept. 11, 1961, United States.

Cylindrical or annular fuel pellets, consisting of a central ceramic fertile region and peripheral ceramic fissile region are manufactured by means of a mould which is divided into compartments with one or more partition walls. The different compartments are filled with fissile and fertile powder respectively, the partition walls are removed and the powders compacted with a single die. The green composite compacts are finally sintered and loaded into a can. (NPO)

39681 OXIDATION REDUCTION PROCEDURE FOR PARTICLE-SIZE REDUCTION OF UO_2. Knudsen, Irving E.; Levitz, Norman M. (to U. S. Atomic Energy Commission). U. S. Patent 3,343,926. Sept. 26, 1967.

A method is described for reducing the particle size of UO_2 by oxidizing UO_2 with less than half the stoichiometric O_2 necessary to completely oxidize to UO_3 and thereafter reducing to UO_2. (AEC)

39682 DENSIFICATION OF REFRACTORY COMPOUNDS. Rossi, Ronald C.; Fulrath, R. M. (to U. S. Atomic Energy Commission). U. S. Patent 3,343,915. Sept. 26, 1967.

A process for producing high-strength refractory metal oxides by sintering the powdered oxide under pressure to a solid having very low porosity and a small grain size is described. The oxide-powder is immersed in a non-polar liquid solvent such as acetone, the solvent replacing the small amount of occluded surface water. The solvent is then evaporated under vacuum and the powder is pressure sintered to form, in the case of Al_2O_3, a solid having a grain size of 1 micron, a density of 99.7% of the theoretical density (3.987 gm/c.c.) and transverse strength approaching 90,000 psi. (AEC)

Properties Evaluations

Refer also to abstracts 39559, 40656, and 40732.

39683 (LA-DC-8881) ACTINIDE CARBIDES: A REVIEW OF THERMODYNAMIC PROPERTIES. Holley, Charles E. Jr.; Storms, Edmund K. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 42p. (CONF-670915-4). Dep. CFSTI.

From Symposium on Thermodynamics of Nuclear Materials with Emphasis on Solution Systems, Vienna, Austria.

Data are presented on the thermodynamic properties of Th, Pa, U, Np, and Pu Carbides. Phase relationships, crystal structures, heat capacities, enthalpies of combustion, EMF measurements, vaporization, enthalpies of formation, and needed further work are discussed. Data are compiled in tables and graphs. (70 references). (M.C.G.)

39684 (NLCO-1001, pp 7.1-11) EVALUATION OF SINTERED CARBIDE CUTTING TOOLS OF SELECTED TaC, WC, AND Co CONTENTS. Burks, D. S. (National Lead Co. of Ohio, Cincinnati).

Ten different grades of sintered carbide tooling composed of varying amounts of TaC, WC, and Co were evaluated in an attempt to relate wear characteristics to chemical composition. Metallographic, analytical, and x-ray microprobe studies supplemented the results of performance testing. (auth)

39685 (SC-DC-67-1999) EQUILIBRIUM DISSOCIATION PRESSURES AND THE PERFORMANCE OF PULSED U–ZrH FUELS AT ELEVATED TEMPERATURES. Simnad, M. T.; Dee, J. B. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). July 24, 1967. Contract AT(29-1)-789. 25p. Dep. CFSTI.

The equilibrium dissociation pressures of U–ZrH fuels in the composition range H/Zr 1.5 to 1.7 at temperatures up to 1300°C were measured. Results of studies of the pressure–composition–temperature relationships above 900°C are discussed. An advanced pulsed fuel demonstration test was carried out to observe the behavior of U–ZrH when subjected to peak fuel temperatures well in excess of those encountered in the standard TRIGA research reactor family. After significant repetitive pulsing there was some evidence that at hot spot regions the fuel surface reached about 1200°C. The test demonstrated that the fuel can operate at the required high-temperature levels with safety and with a reasonable core life. (M.C.G.)

39686 (LA-tr-67-40) ON CERTAIN POINTS OF THE THERMOCHEMISTRY OF THE CARBIDES OF VARIABLE COMPOSITION. Kornilov, A. N.; Zaikin, I. D. Translated by A. D. Cernicek (Los Alamos Scientific Lab., N. Mex.), from Zh. Fiz. Khim., 41: 351-7(1967). 16p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

Mathematical equations were developed to determine formulas of carbides of variable composition. Calorimetric methods were used to determine heats of combustion of NbC and TaC and data based on experimental evaluation of adsorbed CO_2 were used to develop equations applicable to other carbides. (P.G.C.)

39687 THE DEPENDENCE ON MICROSTRUCTURE OF THE HIGH TEMPERATURE PROPERTIES OF URANIUM OXIDE–

MOLYBDENUM AND URANIUM OXIDE–TUNGSTEN CERMETS. II. HEAT TRANSFER PROPERTIES. Giuliani, S.; Mustacchi, C.; Amato, I.; Colombo, R. L.; Coselli, R. (EURATOM-CCR, Ispra, Italy. FIAT, Turin). Rev. Int. Hautes Temp. Refract., 4: 77-83(Apr.-June 1967).

The thermal heat transfer properties of uranium oxide-molybdenum and uranium oxide-tungsten cermets made with several different methods and meant for the fabrication of nuclearly fuelled plasma cells are measured between R. T. and 1,400°C. It is found that the heat transport mechanism cannot be pure conduction, owing to the infra-red radiation transparency of uranium oxide at high temperatures. Experimental results are discussed both from fundamental and technological points of view. (auth)

39688 MEASUREMENT OF THE ACTIVATION ENERGY OF THE BEGINNING OF CALCINATION OF URANIUM DIOXIDE BY THE METHOD OF DORN. Bacmann, Jean-Jacques; Cizeron, Georges (CEA, Gif-sur-Yvette, Essonne, France). Compt. Rend., Ser. C, 264: 2077-80(June 26, 1967). (In French).

The method of Dorn, generally used for the measurement of activation energies of creep phenomena, was applied to the study of the first stage of the calcination of UO_2. An activation energy in the neighborhood of 100 kcal was found, which confirmed the results obtained by other methods. (tr-auth)

39689 SINTERING OF PURE THORIUM OXIDE. Oel, Heribert J. (Max-Planck-Institut fuer Silikatforschung, Wuerzburg, Ger.). Z. Metallk., 58: 569-72(Aug. 1967). (In German).

ThO_2 powder of high purity having optimum properties for further processing was produced by thermal decomposition of the oxalate. With the aid of dry pressing and sintering between 1700 and 1900°C, firm, compact bodies of regular structure were produced. The change in size of crystallites and pores on sintering was examined in detail. The experimental results agree with theoretical considerations which show that grain is mainly dependent on two factors, the grain boundary energy γ and a kinetic factor u_k. It is more difficult to derive theoretical equations for the decrease in porosity, therefore the evaluation of the experimental data is less accurate. However, a simplifying equation was confirmed within the bounds of experimental error. (J.G.B.)

39690 ON THE VAPOR AND EVAPORATION HEAT OF CERIUM, SAMARIUM, GADOLINIUM, AND TERBIUM HEXABORIDES. Gordienko, S. P.; Fesenko, V. V.; Fenochka, B. V. (Inst. of Problems in Materials Studies, Kiev). Zh. Fiz. Khim., 40: 3092-7(Dec. 1966). (In Russian).

Investigation of the evaporation of CeB_6, SmB_6, GdB_6, and TbB_6 showed that at 1900 to 2300°K the vapor effusing from the Knudsen cell consisted mainly of atoms of the respective metals. The evaporation reaction formula in the temperature range examined was $LnB_{6(solid)} = Ln_{(gas)} + 6B_{(solid)}$. An attempt was made to correlate the heat of evaporation with the electron structure of the rare earth metals. (R.V.J.)

39691 STRUCTURE AND PROPERTIES OF SOLID SOLUTIONS OF WC IN TiC, NbC, AND TaC. Funke, V. F.; Panov, V. S. Izv. Akad. Nauk SSSR, Metal., No. 6, 146-53(Nov.-Dec. 1966). (In Russian).

Metallographic and x-ray analyses were used for determining the density, electric conductivity, and microhardness of NbC–WC, TaC–WC, and TiC–WC. The results showed that higher concentrations of WC increased the hardness and specific electric conductivity of the solid solutions of the carbides examined. It also reduced the maximum angle of wetting of the carbide solid solutions by nickel. The larger the variation in the energy and enthalpy of carbide formation and the atomic number of the carbide metal between the WC and the dissolving-carbide the higher the concentration and the greater the change in the properties of the compound. The maximum concentration of WC in NbC and TaC was found at 1450 and 2000°C which is in agreement with published data. (R.V.J.)

39692 THE FRACTURE OF BRITTLE MATERIALS. Pugh, S. F. (Atomic Energy Research Establishment, Harwell, Eng.). Brit. J. Appl. Phys., 18: 129-62(1967).

A review is presented of the nature of cleavage cracks and the structural features and mechanisms which contribute to the nucleation of cracks. Phenomena which assist or retard crack propagation in a wide variety of materials are examined. (auth) (UK)

39693 BUFFERING OF URANIUM MONOCARBIDE TO CONTROL CARBON ACTIVITY. Chubb, W. (Battelle Memorial Inst., Columbus, Ohio). Nucl. Sci. Eng., 29: 176-9(Aug. 1967).

Utilization of the theoretical principle that activities must remain constant at constant temperature and pressure if the number of phases present is equal to the number of elemental constituents present is described. The potential is outlined for use of this principle to achieve compatibility between UC and certain metals. A sample of UC alloyed with 5 at. % W to control its carbon activity showed no embrittlement of stainless steel after being in positive contact for 3000 hr at 800°C (1472°F). (auth)

39694 MICRO-PLASTICITY OF URANIUM DIOXIDE AT ROOM TEMPERATURE. Hasiguti, Ryukiti R. (Tokyo Univ.); Domoto, Kazushige. Sogo Shikensho Nempo, 24: No. 2, 92-9 (Mar. 1966). (In Japanese).

Microplastic deformation was observed in the prefracture process of UO_2 at room temperature by means of strain–rate dependence of flow stresses, ultrasonic measurements, and etch pit techniques, using fused single crystals and sintered pellets. The difference between the ultrasonic attenuation of the compressed state and that of the annealed state showed the maximum as measured as a function of frequency. This is interpreted to be the resonance damping of dislocations introduced by plastic compression. The frictional force of dislocation movement was obtained from the over-damped region. The value was 1 to 3×10^{-2} in sintered pellets and $\sim 1 \times 10^{-3}$ in fused single crystals. (NSA of Japan)

39695 STRESS-CORROSION CHARACTERISTICS OF A Ti–7 Al–2 Nb–1 Ta ALLOY. Leckie, H. P. (U.S. Steel Corp., Monroeville, Pa.). Corrosion, 23: 187-91(July 1967).

The stress-corrosion behavior of a Ti–7Al–2Nb–1Ta alloy was evaluated using the cantilever-beam method. The evaluation included effects of applied anodic and cathodic potentials, specimen loading method, and presence of hydroxyl ion as inhibitor. When a specimen was loaded in air, stress-corrosion cracking could be almost eliminated by allowing the protective oxide film, ruptured by stress, to heal before adding the electrolyte. Stressing the specimen and thus rupturing the passive film in a chloride environment, however, resulted in a very pronounced susceptibility to stress-corrosion cracking and short times to failure. Potentials more active than −1.3 volts (versus saturated calomel electrode) afforded cathodic protection to the alloy tested, which, surprisingly, appeared to be immune to hydrogen embrittlement. Stress-corrosion cracking of this Ti alloy was found to be caused by the rupturing of the protective oxide film followed by stress-corrosion cracking by an active path mechanism. (auth)

Structure and Phase Studies

Refer also to abstract 39558.

39696 (NLCO–1001, pp 6.1-5) METALLOGRAPHIC EXAMINATION OF DILUTE URANIUM–PHOSPHORUS ALLOYS. Craig, K. R. (National Lead Co. of Ohio, Cincinnati).

A uranium–phosphorus system containing 600 to 700 ppM phosphorus was cast without the appearance of primary uranium phosphide. An estimate of the eutectic composition for the pseudo-binary system, uranium-uranium monophosphide was made, which was considerably lower than previously published results. (auth)

39697 PHASE EQUILIBRIUM IN A TERNARY SYSTEM OF Hf–Re–C. Fedorov, T. F.; Gladyshevskii, E. I.; Gorshkova, L. V. Izv. Akad. Nauk SSSR, Metal., No. 6, 134-6(Nov.-Dec. 1966). (In Russian).

An attempt was made to construct the phase equilibrium diagram of a Hf–Re–C alloy using as initial material powdered (99.2% pure) Hf and (99.9% pure) Re and spectrally pure graphite thermally treated by consequent annealing (20 hr at 1600 to 2200°C and 350 hr at 1500°C). X ray and phase analyses and microstructure studies were made of prepared specimens. The diagram exhibited the equilibrium of all binary phases with HfC. HfC dissolved a small amount of Re (less than 5 at. %). Alloys with 70 at. % Hf were not in equilibrium. The alloys containing Re in addition to hexagonal modification exhibited a solid solution based on cubic modification near beta Hf. (R.V.J.)

39698 ON THE STRUCTURE OF HIGH CARBON HYPERSTOICHIOMETRIC URANIUM CARBIDE SINGLE CRYSTALS. Eyre, B. L.; Bartlett, A. F. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag., 15: 995-1003(May 1967). (AERE-R-5305).

Thin films of high-C UC_2 were examined in the electron microscope. The structure consists basically of UC_2 platelets in a UC matrix. The UC_2 platelets contain both coarse twins and fine closely spaced fault bands. The results of diffraction contrast experiments indicate that the faults are in fact thin twins. These features are consistent with the UC_2 platelets having formed basically by a shear transformation. (auth) (UK)

39699 THE CRYSTAL STRUCTURE OF Li_4UF_8. Brunton, G. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. J. Inorg. Nucl. Chem., 29: 1631-6(July 1967). (ORNL-P-2645).

The compound Li_4UF_8 crystallizes in space group Pnma with $a_0 = 9.960$, $b_0 = 9.883$, and $c_0 = 5.986$. The x-ray density is 4.71 g/cm³ and Z = 4. Twenty-four positional parameters, four aniso-

tropic U temperature factors, and seven isotropic temperature factors were determined from 634 independent reflections measured by the 2θ-scan technique with a scintillometer. The parameters were refined by least squares to an R factor of 0.082. Absorption corrections were made for CuKα radiation on an oblate spheroid with a short 36 μ axis, [001], and a 64 μ dia for the circular section. The U^{4+} ion has $8F^-$ nearest neighbors with bond distances of 2.21 to 2.39 Å. The next three nearest neighbors are $2Li^+$ and another F^- at 3.27 and 3.30 Å, respectively. The nine F^- ions are at the corners of a 14-faced polyhedron which has the form of a triangular prism with pyramids on each of the three prism faces, and the two Li^+ ions are at the centers of irregular F^- octahedra which share faces with the U polyhedron. The Li^+-F^- distances are 1.82 to 2.28 Å. (UK) (auth)

39700 PHASE EQUILIBRIUM STUDIES IN THE UO_2-ZrO_2 SYSTEM. Romberger, K. A.; Baes, C. F. Jr.; Stone, H. H. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. J. Inorg. Nucl. Chem., 29: 1619-30(July 1967). (ORNL-P-2792).

Phase equilibria in the UO_2-ZrO_2 system were studied from 600 to 1130°C by agitation of mixtures of the separate oxides or solid solutions of the oxides in the presence of a molten salt solution ($LiF-BeF_2-UF_4-ZrF_4$). After quenching, the oxide phases were freed of fluorides by water washing, separated by dissolution of the UO_2 phase in nitric acid, and then analyzed. From the results it was concluded that at a eutectoid temperature of 1110 ± 5°C the three equilibrium solid solutions were tetragonal ZrO_2 with 2.8 m/o (mole percent) UO_2, monoclinic ZrO_2 with 0.2 m/o UO_2, and cubic UO_2 with 0.38 m/o ZrO_2. Below 1110°C the compositions of the monoclinic ZrO_2 and cubic UO_2 phases were approximated by $\log X_{UM} = -2.003 - 998/T$ and $\log X_{ZC} = -2.201 - 298/T$ (wherein X_{UM} is the mole fraction of UO_2 in ZrO_2 and X_{ZC} is the mole fraction of ZrO_2 in UO_2). Above 1110°C the small mutual solubilities of the cubic UO_2 and tetragonal ZrO_2 phases were compared with published data showing much higher solubilities at higher temperatures. This was done by plotting log D vs. 1/T, in which D is a distribution ratio for either UO_2 or ZrO_2. These plots indicated that the published data below 1500°C are in error. They also indicated that the solid solutions involved were ideal only at the lowest concentrations. A revised phase diagram is proposed in which exsolution of UO_2 and ZrO_2 is nearly complete at a eutectoid temperature (1110°C) which is ~1000°C higher than a previous estimate. (UK) (auth)

Radiation Effects

Refer also to abstracts 39653, 39660, 40675, and 40719.

39701 (AD-650195) EFFECTS OF RADIATION ON SEMICONDUCTOR MATERIALS AND DEVICES. Final Report, October 1, 1964-November 30, 1966. Wilson, D. K.; Mitchell, J. P.; Cuthbert, J. D.; Blair, R. R. (Western Electric Co., Inc., New York. Bell Telephone Labs., Inc., New York). Dec. 31, 1966. Contract AF 19(628)-4157. 256p. (AFCRL-67-0068). CFSTI.

Results of investigations on the effects of nuclear radiation on semiconductor materials, device surfaces, and devices are discussed. Radiation damage in GaP was studied using electro- and cathodo-luminescence. Studies were also made of radiative and non-radiative recombination mechanisms in various compound and elemental semiconductors. A non-radiative Auger-type mechanism observed at neutral defect centers appears to explain non-radiative lifetime degradation from both chemical and radiation damage defects. The Fermi level dependence of the ESR spectrum associated with the phosphorus-vacancy complex was studied in electron-bombarded, phosphorus-doped LOPEX silicon. These studies confirm one assumption that the Si-G8 (E) center is not seen until the Fermi level falls below E sub C -0.48 eV. Experiments to determine the effects of device bias, temperature, and radiation dose rate on surface damage to MOS FET's showed qualitative agreement with a model of positive space charge build-up at traps in the devices' SiO_2 layer. (auth)

39702 (HW-83737) AN INVESTIGATION OF THE GRAPHITE-WATER VAPOR SYSTEM UNDER ^{60}Co GAMMA IRRADIATION. Interim Report. Woodley, R. E. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Aug. 20, 1964. Contract AT(45-1)-1350. 32p. Dep. CFSTI.

The graphite-water vapor system is being investigated in the presence of ^{60}Co γ radiation of dose rates up to about 3×10^6 R/hr, temperatures to 700°C, and water vapor concentrations to approximately 6000 ppM. Although the results indicate interference by very small concentrations of O_2, it appears that the upper limit for the graphite oxidation rate under the present experimental conditions is about 8×10^{-7} g/g/hr. Moreover, the oxidation rate in the complete absence of O_2 may well be appreciably less than this value. (auth)

39703 THE IRRADIATION BEHAVIOR OF UO_2-STAINLESS STEEL CERMETS BETWEEN 550 TO 700°C. Lambert, J. D. B. Nucl. Energy, 106-11(July-Aug. 1967).

Rods and plates of UO_2/AISI Type 316L stainless steel, with 30 to 60 vol % UO_2 content, were irradiated to 4 to 10 at. % burn-up. From the results of the experiments which are described it is concluded that the presence of voidage in the UO_2 particles has a beneficial effect. It was found that the excellent irradiation performance of this type of fuel is generally maintained when operated at 550 to 700°C and with a UO_2 content of 60 vol %. (UK)

Plastics and Other Materials

Refer also to abstracts 39692, 40704, and 40712.

39704 (BMI-X-10203) HEAT-RESISTANT CONCRETE FOR PRESTRESSED-CONCRETE-PRESSURE-VESSEL (PCPV) REACTORS. Quarterly Progress Report, April-June 1967. Lankard, David R.; Fondriest, F. Frederick; Snyder, M. Jack (Battelle Memorial Inst., Columbus, Ohio). July 1, 1967. Contract W-7405-eng-92. 9p. (EURAEC-1905). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Four additional moisture migration experiments have been initiated so that data are now being taken on eight moisture migration specimens. Limestone and gravel concrete mixes having 28- and 90-day cures at 250 and 500°F are represented. An improved procedure for measuring the free and combined water content specimens has been established. Limestone and gravel concrete mixes containing fly ash as an additive have been prepared. The gravel and limestone mixes selected for use have a 28-day compressive strength of approximately 5500 psi. Cylindrically shaped moisture migration specimens have been prepared using both fly ash mixes. Long-term creep tests at room temperature have been initiated on 28-day concrete specimens. (auth)

39705 (COO-1149-96) THERMODYNAMICS OF SEMI-METALLIC COMPOUNDS. Westrum, Edgar F. Jr.; Lyon, W. G. (Michigan Univ., Ann Arbor. Dept. of Chemistry). Aug. 1967. Contract AT(11-1)-1149. 21p. (CONF-670915-3). Dep. CFSTI.

From Symposium on Thermodynamics of Nuclear Materials with Emphasis on Solution Systems, Vienna, Austria.

The firm status of thermal and thermochemical knowledge of the semi-metallic compounds is briefly evaluated and correlated with that of related alloys, intermetallic compounds, and semiconducting compounds. However, emphasis is focused on the actinide and lanthanide compounds with elements of groups IIIA, VA, and VIA. These binary compositions with rock salt and related structures occasion fascinating interactions of crystallographic, electronic, and magnetic contributions to the thermal behavior. Although actinide compounds have an obvious nuclear technological import, data on the corresponding lanthanide compositions provide a very useful extension of parameters as well as a basis for understanding the more complex relationships existing over truncated ranges in the actinides. For example, the five 5f-6d electronic orbital problem makes interpretation of electronic, magnetic data especially difficult. The complications introduced in both series by the conduction electrons hinder facile interpretation. The thermal properties of the lanthanide hexaborides are shown to exhibit largely unexplained anomalies and, like many of the other compounds discussed, offer interesting possibilities for technological and possibly nuclear applications. (auth)

39706 (SC-DR-67-535) LOW COEFFICIENT OF THERMAL EXPANSION EPOXY ENCAPSULATING COMPOUND. Curlee, Richard M. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. Contract AT(29-1)-789. 16p. Dep. CFSTI.

Fused-SiO_2-filled epoxy encapsulants with low coefficients of thermal expansion and reduced specific gravities were developed to be processed at moderate temperatures. Test results are reported on mechanical, thermal, and electrical properties of the fused-SiO_2 filler. (auth)

39707 PROPERTIES OF IRRADIATED POLYETHYLENE NEAR THE MELTING POINT. Tsuji, Yoshio; Tada, Shotaro; Kawashima, Maumi. Denki Gakkai Zasshi, 87: 406-11(Feb. 1967). (In Japanese).

Some details of the mechanical and electrical properties of polyethylene were studied in relation to temperature and radiation dose. Temperature dependence of the tensile strength, elongation, deformation, insulating resistance, and dielectric loss were considered. The temperature dependence of elongation depended on the radiation dose. Thin polyethylene strips with constant weight were used for testing; the lengths were measured as a function of temperature. In the length-temperature curve, the differences depending on the radiation dose below 30 MRAD were shown dis-

tinctly. Soon after irradiation, under rising temperature, it was observed that the insulating resistance was markedly decreased and the dielectric losses markedly increased near the melting point. These phenomena could be shown only at the first temperature rise and only for irradiated polyethylene. It is considered that these phenomena are due to the electrons and radicals trapped in the crystalline polymer. They are then released and extinguished near the melting point. It was concluded that irradiated polyethylene can be used as an electrical material after heat treatment has been performed. (BBB)

39708 THE WEAR PROPERTIES OF HIGH-DENSITY POLYETHYLENE IRRADIATED BY GAMMA RAYS. **Matsubara, K.; Watanabe, M. (Government Mechanical Lab., Tokyo). Wear, 10: 214-22(May-June 1967).**

The wear properties of γ-irradiated polyethylene were compared with those of unirradiated samples. The specimens were irradiated using ^{60}Co at dose rates from 3.5×10^4 to 8.1×10^5 R/hr to a maximum dose of 2×10^8 R. The wear of specimens sliding on a steel specimen coated with Cr over a load range from 5 to 20 Kg/cm^2 is shown as weight loss per sliding distance of 1000 m. Loads from 5 to 10 Kg/cm^2 had little effect on the unirradiated samples; however, at a load of 12 Kg/cm^2 the whole sliding surface melted over a few millimeters. The relation between area and radiation dose was expressed linearly up to about 2×10^8 R, and when the dose exceeded this value, the wear became abnormally low. At a load of 10 Kg/cm^2, the wear increased with increasing radiation dose. The variation of wear with radiation dose could be explained by the % of crosslinking, which increases with increasing radiation dose. The results of wear tests with an abrader were about the same as those without an abrader. (TSS)

39709 INERT GAS BUBBLES IN NEUTRON-IRRADIATED MAGNESIUM OXIDE. **Morgan, C. S.; Bowen, D. H. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag., 16: 165-80(July 1967). (AERE-R-5223).**

In MgO, irradiated with neutrons at 150°C, 600°C, and 1000°C to doses greater than 10^{20} nvt > 1 MeV, rectilinear bubbles were observed by transmission electron microscopy after annealing at temperatures above 1500°C. In specimens irradiated at 150°C the bubbles had {100} surfaces and sides ranging from 40 to 400 Å, and measurements of the residual growth of the crystals after annealing were correlated with the volume occupied by the bubbles. Electron microscope and gas release studies indicated that the bubbles form primarily by vacancy condensation and subsequently act as sinks for the diffusion of Ne and He produced by the transmutation of Mg and O. It is suggested that mechanical release of these gases, by crushing the crystals at room temperature, could take place by two processes: the intersection of bubbles by cracks and transport of gas via irradiation-induced dislocations. In a crystal irradiated at 1000°C, large precipitates were formed that, on annealing, dissolved, leaving behind bubbles up to 2000 Å in size, having a variety of crystallographic shapes. (auth) (UK)

39710 INTERSTITIAL LOOPS IN GRAPHITE, THEIR MOTION AND THEIR EFFECT ON ELASTIC MODULUS. **Thrower, P. A. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag., 16: 189-205(July 1967). (AERE-R-5351).**

Electron microscope observations of interstitial loops in graphite have provided many examples of their interactions with basal plane dislocation lines. The motion of the loops due to the force of an approaching dislocation, and the pinning of these dislocation lines by a high density of small loops are discussed. Both effects are analysed in the light of a recent theoretical treatment of such interactions in anisotropic materials. Conditions under which loop movement occurs are examined and compared with theory and the process is shown to be unfavourable for loops of radius greater than 150 Å. Calculated criteria are obtained for the pinning of the dislocation lines by the introduction of a saturation pinning stress which is independent of irradiation temperature, and when combined with the theory of nucleation and growth of loops in graphite it is possible to calculate the irradiation dose for which saturation of elastic modulus is obtained as a function of irradiation flux and temperature. The application of these results to polycrystalline graphite is considered and a comparison made with experimental observations. Suggestions are made for further analysis and experiment. (auth) (UK)

39711 METHOD OF INHIBITING RADIATION DAMAGE TO ORGANIC MODERATORS AND COOLANTS. **(to Nihon Genshiryoku Kenkyu Sho). French Patent 1,374,586. Aug. 31, 1964. Priority date Nov. 27, 1962, Japan.**

Radiation damage to polyphenyls is decreased by addition of one or more of the following inhibitors: pyrene, anthraquinone, hydroquinone, triphenylmethane, tetramethylthiuram disulfide. (NPO)

39712 METHOD FOR CAPTURING IODINE COMPOUNDS OBTAINED BY FISSION IN CERAMIC FUELS. **(to Nihon Genshiryoky Kenyo Sho). French Patent 1,357,145. Feb. 24, 1964. Priority date Mar. 1, 1962, Japan.**

MgO and $\alpha-Al_2O_3$ powders are capable of trapping iodine compounds at 900 to 1100°C, in contradistinction to the customary Cu traps which require a temperature of 350 to 450°C. Thus MgO and $\alpha-Al_2O_3$ can be utilized in high temperature ceramic fuel elements as iodine traps. (NPO)

39713 POLYOLEFIN MASTIC. **(to Kleber Colomber Pneumatiques Caoutchouc Manufacture et Plastiques). French Patent 1,335,552. July 15, 1963. Filed June 30, 1962.**

A dispersion of a powdered polyolefin in a liquid thermosetting resin of the polyester, polyepoxy, urea$-CH_2O$ or phenol$-CH_2O$ type will harden in the course of time and can be used as a castable moderator material. (NPO)

PHYSICS (GENERAL)

Astrophysics

Refer also to abstracts 39818, 39819, 39839, 39858, 39868, 40011, and 40127.

39714 (TID-23971, pp 1-122) GENERAL PHYSICS. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Further research is presepted on the following areas; (1) molecular beams, (2) molecular energy transfer and spectroscopy, (3) microwave spectroscopy, (4) atomic resonance and scattering, (5) radio astronomy, (6) optical and infrared spectroscopy, (7) geophysical research, (8) magnetic resonance, (9) physical electronics and surface physics, (10) physical acoustics, (11) electrodynamics of media, and (12) physical optics of invertebrate eyes. (M.O.W.)

39715 STELLAR FREQUENCY DISTRIBUTION AND ORIGIN OF CHEMICAL ELEMENTS. Unsoeld, A. (Univ., Kiel). Z. Phys., 202: 13-21(1967). (In German).

The hypothesis that the heavier elements (i.e., all elements except H and possibly He) are formed in connection with the origin and collapse of stars runs into many difficulties. In the small density of the original halos of the Milky Way, star formation cannot occur a multiple faster than today. The origin of the galactic disc from the gas of the halo (after formation of the halo star) is not compatible with the observation that the angular momentum of the galactic orbital motion per mass unit for the extreme halo population II is much smaller than for the disc population. The hypothesis is advanced, therefore, that the heavy elements were formed principally in a powerful explosion in the core of the Milky Way approximately 7×10^9 years ago; this assumption is compatible with present knowledge of cosmic time intervals. This indicates that the relative frequency of all heavy elements in stars of extremely small, normal, and twice supernormal metal frequency are the same within the analysis accuracy. The empirical rule found by Suess on the frequency distribution must be accessible within the framework of the new hypothesis before an explanation is possible. The frequency ratio He:H is discussed in detail. The production of heavy elements in individual stars and supernovae is considered. Empirical results do not indicate that such processes have significantly influenced the frequency distribution in the majority of stars or in interstellar matter. (tr-auth)

39716 PHYSICS OF COMETARY PLASMA. Wallis, M. K. (Univ. of Manchester, Eng.). Planet. Space Sci., 15: 1407-18 (Sept. 1967).

Assuming that plasma instabilities and possibly an enhanced interplanetary magnetic field ensure the fluid behaviour of cometary plasma, the production and flow of plasma in a carbon monoxide comet under the influence of the solar wind is investigated. The solar wind heats and compresses the cometary plasma. CO^+ production occurs mainly through electron-collisional ionization of the CO, in a region of slowly moving plasma sunward of the comet nucleus. This region is determined as the position of balance of the solar and cometary plasma momentum fluxes and for various sizes of comets its distance lies in the range 2 to 50,000 km. Some 20 to 50 times further out, however, charge exchange processes (plus some photoionizations) become more important than electron collisions in causing ionization. Only the giant comets are efficient at ionizing the CO, and their plasma mostly occurs in envelopes at a distance of few times 10^4 km, whence it flows at high velocity into tail rays. In the lesser comets much of the plasma is cooled to energies of a few eV through the electron collisional ionizations and excitations of CO molecules. This plasma flows on through the head and, before it reaches the tail, promotes the dissociation of complex molecules. Here may be identified the so-called "active region" or "false nucleus." (auth)

39717 p-PROCESS ELEMENTS PRODUCED IN SUPERNOVA ENVELOPE. Duorah, H. L. (Univ. of Gauhati, India). Indian J. Pure Appl. Phys., 5: 111-13(Apr. 1967).

The abundances of the proton-rich nuclei, which are produced in a proton-capturing chain, are calculated. The astrophysical situations in which this chain takes place are supposed to be in the envelope of supernova type I in which heavier elements are produced in the interior through rapid neutron capture. A long chain is, however, found to be out of place. It is suggested that modifications taking into account electron capture at high-electron-density conditions and allowed transitions may produce a reasonably long proton-capturing chain. (auth)

39718 ALTERNATIVE CAUSE OF THE SOLAR OBLATENESS. Cocke, W. J. (Goddard Inst. for Space Studies, New York). Phys. Rev. Lett., 19: 609-11(Sept. 4, 1967).

It is shown that the turbulent viscosity forces acting on photospheric meridional currents could cause the solar photosphere to be oblate by more than ±70 km. Although the sign of the effect is undetermined, this might remove the alleged discrepancy in Einstein's prediction for the perihelion advance of Mercury. (auth)

39719 THERE IS NO UNIQUE INTERPRETATION FOR THE SOLAR LYMAN α PROFILE. Hearn, A. G. (Joint Inst. for Lab. Astrophysics, Boulder, Colo. High Altitude Observatory, Boulder, Colo.). Mon. Notic. Roy. Astron. Soc., 136: 417-24(1967). (CLM-P-128).

Calculations of the profiles of lines emitted by an atmosphere in which the electron temperature, the electron density, and the Doppler width are allowed to vary show that the observed profile of the Lyman α line of hydrogen emitted by the Sun may be produced by atmospheres which have a wide range of Doppler widths. Consequently, there is no unique interpretation possible for the Lyman α profile alone. The simultaneous measurement of the Lyman β profile will give additional information, but without further observations and calculations it is not clear if a unique interpretation may be made. (auth)

39720 ON BETA CEPHEI STARS: A SEARCH FOR BETA CEPHEI STARS. Hill, Graham (Univ. of Texas, Austin. Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., Suppl. Ser., 14: Suppl. No. 130, 263-300(Aug. 1967).

The results of a photoelectric search for β Cephei stars among a sample of 153 early B stars, found in the nearest associations and galactic clusters, are presented. This search yielded 24 new β Cephei stars (including 5 tentative ones), thereby increasing the number of known β Cephei stars to 41. These new observations have extended considerably the limits of spectral type, luminosity class, absolute magnitude, period, and rotational velocity for these variables. The limits now become 09.5−B3 (spectral type), V−I (luminosity class, 3 to 10 hr (period), 0 to >300 km/sec (rotational velocity). An examination of the period−luminosity relation leads to the tentative conclusion that those stars with periods $<0^d.3$ obey a p − l relation, but the stars with periods $\geq 0^d.35$ do not. H−R diagrams of β Cephei variables and "normal" stars for individual associations and galactic clusters show that the β Cephei stars occupy no preferred position in relation to normal stars, i.e., many of these "normal" stars are at the same stage of evolution as the β Cephei stars. (auth)

39721 SOME NEW VARIABLES IN NEARBY ASSOCIATIONS AND GALACTIC CLUSTERS. Hill, Graham (Univ. of Texas, Austin. Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., Suppl. Ser., 14: Suppl. No. 130, 301-6(Aug. 1967).

Data are presented for 20 new variable stars discovered in some of the nearby galactic clusters and associations. These variables include 9 eclipsing binaries (including 4 doubtful cases), 3 variable emission-line or peculiar stars, and 8 variables of unknown type. (auth)

39722 HIGHER MODES OF NONRADIAL OSCILLATIONS OF STARS BY VARIATIONAL METHODS. Andrew, A. L. (La Trobe Univ., Bundoora, Australia). Aust. J. Phys., 20: 363-8 (Aug. 1967).

The Ritz method is applied to a variational principle of Chandrasekhar to determine the normal modes of nonradial oscillation of a massive star. Although good results are obtained for the f mode and the p modes, it is shown that the method may fail to detect the g modes. The effect of the choice of coordinate functions is considered. (auth)

39723 OH OBSERVATIONS IN THE DIRECTIONS OF GALACTIC THERMAL SOURCES. McGee, R. X.; Gardner, F. F.; Robinson, B. J. (CSIRO, Chippendale, Australia). Aust. J. Phys., 20: 407-20(Aug. 1967).

A survey for the hydroxyl line radiation was made in the directions of 30 radio sources (most of them thermal) with the 210 ft telescope of beamwidth 12′·2 and the multichannel line receiver of bandwidths 10 and 37 kHz. The line at frequency 1665.401 MHz was observed for all sources and the other three lines at 1612, 1667, and 1720 MHz were observed for 10 of the more important sources. The latter were investigated for circular and linear polarization.

Twenty-six sources showed absorption lines in their directions, many at two or more radial velocities. Apparent opacities ranged from 0.4 to less than 0.002. Fourteen sources showed emission lines. In general, the emission was strongly circularly polarized. Linear polarization was low except for a value of 45% in one source. An attempt was made to locate the OH clouds in space with the aid of a model of galactic rotation. OH gas appeared to be spread throughout the spiral arms of hydrogen. The ratio of OH to H_I was less in the outer arms than towards the center source Sagittarius A but it varied somewhat randomly in the inner arms. There is little doubt that OH emission and in many cases OH absorption occur close to H_{II} regions. (auth)

39724 A THEORY OF SOLAR TYPE-IV EMISSION ON CENTIMETRE AND DECIMETRE WAVELENGTHS. Yip, W. K. (Univ. of Tasmania, Hobart, Australia). Aust. J. Phys., 20: 421-43(Aug. 1967).

Assuming models for electron density and magnetic field configuration in the lower solar active corona, it is proposed that type-IV bursts on centimeter and decimeter wavelengths are the results of cyclotron radiation from helical electron streams. In order to explain the observed polarization features and spectral variabilities, the characteristics of cyclotron radiation from electron streams and the propagation of electromagnetic waves in the active corona are investigated. Adopting the current model for flare evolution, most of the properties of type-IV bursts on centimeter and decimeter wavelengths are well interpreted by the present theory. (auth)

39725 LOW-FREQUENCY ABSORPTION IN ISOTROPIC WORLD MODELS. Payne, A. D. (Univ. of Tasmania, Hobart, Australia). Aust. J. Phys., 20: 445-53(Aug. 1967).

The free–free absorption by intergalactic ionized hydrogen of the radiation from discrete radio sources is considered. The absorption for different world models was calculated as a function of red shift, electron density, and temperature. (auth)

39726 LOCAL STRUCTURE OF THE GALACTIC MAGNETIC FIELD. Bingham, R. G.; Shakeshaft, J. R. (Cavendish Lab., Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc., 136: 347-63 (1967).

Observations of the polarization and brightness distribution of the galactic nonthermal radio emission are used in conjunction with other evidence to deduce the structure of the interstellar magnetic field within about 1.5 kpc of the Sun. Analysis of the different sources of information and different regions of the sky consistently indicates that the magnetic field is curved and convergent in the region considered, when drawn projected onto the galactic plane. There is also some evidence on the components of the field not parallel to the plane, and the thickness of the magnetic disk is discussed. The magnetic field structure deduced is apparently related to the local stellar spiral arm. (auth)

39727 LOW NOISE SOLAR AND LABORATORY SPECTROSCOPY. I. TECHNIQUE. Blackwell, D. E.; Petford, A. D.; Mallia, E. A. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc., 136: 365-79(1967).

A calculation of the theoretical signal to noise ratio for optical solar spectra formed by grating spectrographs is given, and it is shown that commonly observed spectra are more noisy than this limit by a factor of more than one hundred. A form of spectrometer designed to yield a low noise level is described. Examples of solar spectra obtained with this instrument are given and it is shown that their noise level is very close to the theoretical limit. (auth)

39728 SOME EFFECTS OF PRESSURE BROADENING IN SOLAR AND STELLAR CURVES OF GROWTH. Warner, Brian (Oxford Univ.). Mon. Notic. Roy. Astron. Soc., 136: 381-8 (1967).

It is shown that the elementary theory of line broadening by collision damping provides adequate explanation of the various bifurcations of the empirical solar curve of growth. The apparent dependence of damping constant of a line on the parity of its lower level also follows. Applications are made to other stars and some early laboratory results by Babcock of pressure shifts in Fe I are qualitatively explained. (auth)

39729 ANGULAR MOMENTUM AND ENERGY EXCHANGED BETWEEN NEARLY COLLIDING STARS. Burke, J. Anthony (Brandeis Univ., Waltham, Mass.). Mon. Notic. Roy. Astron. Soc., 136: 389-401(1967).

Two nonviscous polytropic gas spheres of index 3 are imagined to suffer a near collision. The amount of vibrational energy and angular momentum transferred from the orbit to each star is calculated. The results indicate that: (1) the vibrational energy transferred is small compared with the gravitational binding energy of the spheres and (2), the angular momentum transferred is much smaller than typical values observed in stars of late spectral class. (auth)

39730 CHEMICAL COMPOSITION OF THE MILD SUBDWARF μ CASSIOPEIAE. Catchpole, R. M.; Pagel, B. E. J.; Powell, A. L. T. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc., 136: 403-15(1967).

An abundance analysis of μ Cas was carried out on the basis of four Palomar exposures in the visual region, using the differential curve-of-growth method. The star has an iron: hydrogen ratio four times lower than that of the Sun and it belongs to the α-rich group discovered by Wallerstein. Relative to iron, Mg, Si, Ca, and Ti are overabundant by factors between 1.5 and 2 and Mn is underabundant by a factor of about 2, while Na, Sc, V, Cr, Co, Ni, Zn, and Y have normal abundances. Less-definite results for Al and Ba imply anomalies not exceeding a factor of 2, and upper limits are derived for Zr, Nd, Eu, and Yb. A recent preliminary estimate of the mass of the primary is combined with the mass–luminosity relation to make an equally preliminary estimate of the helium abundance. $Y \approx 0.26$, which is strengthened by reference to the very similar star 85 Pegasi. The "spectroscopic gravity," which could in principle yield a second estimate of Y, appears to be much too inaccurate to be of use for this purpose. (auth)

39731 STUDY OF THE BEHAVIOR AT INFINITY OF THE SPECIFIC INTENSITY IN A PLANE PARALLEL ATMOSPHERE. Feautrier, P. (Observatoire de Meudon, France). Ann. Astrophys., 30: 347-8(Mar.-Apr. 1967). (In French).

The equations representing the behavior at infinity of the specific intensity in a plane parallel atmosphere were derived beginning with the flux constancy without using any hypothesis other than the positivity of the functions I and S and the fact that a semi-infinite atmosphere is infinitely thick to all the wave lengths. (J.S.R.)

39732 EFFECTS OF NONCONSTANT OPACITY ON THE VIBRATIONAL STABILITY OF PURE HELIUM STARS. Noels-Groetsch, A. (Univ., Liege). Ann. Astrophys., 30: 349-50 (Mar.-Apr. 1967). (In French).

The vibrational stability of pure helium stars was studied beginning with models constructed by consideration of the following opacity law: $\varkappa = 0.2 \times [1 - 0.0235795\ kT + 0.000295975\ (kT)^2]$. The characteristics of the models are given for different values of the mass. The radial oscillation characteristics at the center and at the surface were calculated. The values of the destabilizing factor obtained were compared with those obtained in other studies. The present values are systematically higher. From these values plus the values calculated for the stabilizing factors, and the coefficient of vibrational stability, a value of 9.2 $M_\odot$ was calculated for the critical mass. This value showed that the introduction of a variable opacity in the calculation of models increases the value of the critical mass appreciably. (J.S.R.)

39733 THE CROSSOVER EFFECT FOR α^2 CVn AND HD 98088. Boehm–Vitense, Erika (Lehrstuhl fuer Theoretische Astrophysik, Heidelberg). Z. Astrophys., 67: 1-14(1967). (In German).

The crossover effect for α^2 CVn can be well understood with the hypothesis of an oblique rotator if the magnetic field and the angles of inclination are taken to be the same as those, which were derived to explain the magnetic variations. On the other hand it can also be shown that a negligible effect is to be expected for HD 98088, if the magnetic field and angles of inclination are determined from the variations of the magnetic field. However the angle of inclination between the axis of rotation and the line of sight i has to be larger than the angle β between the axis of rotation and the magnetic axis. (auth)

39734 VARIABILITY OF MAGNETIC STARS AND THE SOLAR MODEL. Tuominen, Ilkka V.; Tuominen, Jaakko (Univ. of Helsinki). Z. Astrophys., 67: 15-23(1967).

If Babcock's theory of the solar magnetic field is considered capable of explaining the magnetic activity of the Sun, it is shown how a similar theory could also provide an explanation for the variability of at least some of the magnetic stars. From the short period of magnetic stars compared with that of the Sun, it follows that: (1) The number of spots living simultaneously will be about equal to that of sunspots within a solar cycle; (2) the factor of amplification of the initial poloidal field will be small compared with that of the Sun; (3) the tilt of bipolar spot groups will be many times greater than in the Sun. If diffusion is fast enough, these results mean that the polar field produced by the stellar spots will be about a thousand times as strong as the field produced by sunspots, and sufficiently strong to reverse the polar field. If not, the observed stellar field may be considered as composed of (1) a constant poloidal field, produced by some other

way, and (2) the integrated field of the spots and magnetic regions, which is variable. On the basis of the latter picture one can also understand the correspondence between the periods of magnetic and light variability and the variability of the sharpness of spectral lines, the crossover effect, and the phase differences in the intensity of different spectral lines. (auth)

39735 EVOLUTION IN A BINARY STAR SYSTEM. III. THE ONSET OF HYDROGEN BURNING NEAR THE SURFACE OF A WHITE DWARF OF INCREASING MASS. **Giannone, P. (Osservatorio Astronomico, Rome); Weigert, A. Z. Astrophys., 67: 41-63(1967).**

An evolutionary sequence was calculated for a homogeneous helium white dwarf of 0.5 $M_{\odot}$. Different models of this sequence are assumed to be members of close binary systems in which the primary evolves and starts to transfer matter to the white dwarf. Accordingly, further evolutionary sequences are calculated for these white dwarfs on which a hydrogen-rich envelope is assumed to increase with time. The newly added hydrogen is shown to be ignited for reasonable rates of mass increase. The new shell source was thermally unstable in all cases which were treated, the type of instability depending on the degree of degeneracy in the shell source. The resulting thermal runaways were followed numerically. When the degeneracy is appreciable then a flash occurs. After removal of degeneracy, the flash is followed immediately by a second thermal runaway which is characteristic for very thin shell sources in a perfect gas. Thus, the temperature is increased much more than it would have been by the flash alone. (auth)

39736 BROADENING OF CADMIUM LINES BY MICROFIELDS. **Kusch, Hans Juergen; Oberschelp, Erhard (Univ., Kiel). Z. Astrophys., 67: 85-9(1967). (In German).**

Line broadening by microfields of 6 Cd I lines and of 8 Cd II lines was measured using pulsed discharges through cadmium diethyl vapor. The results were presented in a table. (auth)

39737 BROADENING OF ZINC LINES BY MICROFIELDS. **Kusch, Hans Juergen; Oberschelp, Erhard (Univ., Kiel). Z. Astrophys., 67: 77-84(1967). (In German).**

Line broadening of 12 Zn I lines and of 4 Zn II lines by microfields was measured using pulsed discharges through zinc diethyl vapor. The results are presented in a table and compared with static Stark effect patterns. (auth)

39738 BROADENING OF SPECTRAL LINES OF CARBON BY MICROFIELDS. **Kusch, Hans Juergen (Univ., Kiel). Z. Astrophys., 67: 64-76(1967). (In German).**

The broadening by microfields of the C I line 2478 Å and of sixteen C II lines was measured using pulsed discharges in methane. The experimental results are tabulated and compared with theoretical values as far as possible. (auth)

39739 RADIATIVE TRANSFER IN A SPHERICAL COMPTON SCATTERING ATMOSPHERE. **Code, Arthur D. (Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., 149: 253-63(Aug. 1967).**

The problem of multiple Compton scattering in a spherical atmosphere is considered. The appropriate equation of transfer is approximately solved following a technique first outlined by Chandrasekhar. Since few transfer problems have been discussed which explicitly take into account the curvature of the atmosphere, the present solution provides some additional insight on the modifications introduced by the inclusion of sphericity. It was found that curvature did not significantly change the spectral redistribution of the emergent radiation. The results could be obtained by combining the solution for the plane-parallel atmosphere with that found for the simpler problem of the total integrated intensity from a spherical atmosphere. (auth)

39740 OBSERVATIONS BEARING ON THE KIPPENHAHN-SCHLUETER QUIESCENT PROMINENCE MODEL. **Thompson III, William I.; Billings, Donald E. (Univ. of Colorado, Boulder). Astrophys. J., 149: 269-73(Aug. 1967).**

One of the implications of the Kippenhahn-Schlueter theory of quiescent prominence support is that the ratio of the maximum stable height, z, of a prominence to the distance from its base to the origin of the supporting magnetic field, D, should be $3^{-\frac{1}{2}}$. From a study of 172 prominences a strong correlation was found between z and D and a marked mode near 1.7 in the D/z distributions. (auth)

39741 EINSTEIN RED SHIFT IN WHITE DWARFS. **Greenstein, Jesse L.; Trimble, Virginia L. (Mount Wilson and Palomar Observatories, Pasadena, Calif. Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena, Calif.). Contract AF49(638)-1323. Astrophys. J., 149: 283-98(Aug. 1967).**

Low-dispersion radial velocities of 53 white dwarfs were measured on Palomar spectrograms. The type, velocity, space-motion components, photometrically deduced temperature and radius, for each star, along with 39 additional radial velocities of very low weight, are given. A few members of wide binary systems and 6 white dwarfs in the Hyades provide direct measures of the Einstein gravitational red shift, with a mean value of +51 km/sec. Omitting the very-high-velocity star LP9-231, there are 37 DA stars, with a mean K-term (expansion velocity) of +65.6 km/sec. If the Hyades stars are omitted, the mean K term is +62.5 km/sec. A number of white dwarfs are members of the high-velocity population. Systematic wavelength shifts of He I lines in DB stars make their velocities more negative than those of DA stars; similar negative shifts may exist for metallic lines. The temperature scale is obtained from colors and, combined with luminosities, gives radii. The broad distribution of radii and red shifts is shown, and median values are derived. The median radial velocity for 37 DA stars is +58 km/sec, and the median radius 0.0107 R⊙; the redshift and radius give a mass of 0.98 M⊙. However, this value is almost certainly too high, if accordance is expected with the theoretical mass-radius relation. The theoretical M–R relation of a zero-temperature degenerate star predicts a redshift, for given mass, for various compositions. Two corrections could bring the theoretically expected redshifts into agreement with the observations. Either a systematic change in luminosity, ΔM_v of +0.25 mag, or a reciprocal temperature change of $\Delta\theta = -0.03$, reduces the median radius to 0.0093 R⊙. The mass derived from the redshift is then 0.86 M⊙. These values are in accordance with the Hamada–Salpeter mass–radius relation, if the composition in the interior is pure helium. A carbon or magnesium interior also gives a radius not too different from the colorimetric radius. An iron core gives a mass of 0.73 $M_{\odot}$, but a radius of 0.008 $R_{\odot}$, sufficiently smaller to require substantial changes in the temperature scale. The mass now derived from the radial velocities is higher than that previously found from radii only and closer to the Chandrasekhar limit. (auth)

39742 ABUNDANCES IN TWO EXTREMELY HIGH-VELOCITY STARS. **Koelbloed, David (Mount Wilson and Palomar Observatories, Pasadena, Calif. Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 149: 299-315(Aug. 1967).**

Techniques of coarse and fine analysis, based on curves of growth, were used to derive abundances in the atmospheres of HD 2665 and HD 6755, two metal-deficient stars of extremely high velocity. Abundances were compared with those in the Sun, using Conti's models for normal and metal-deficient K giants; the ions, for normal abundances, were found to have a higher excitation temperature than the neutral atoms, but this difference disappears in the metal-deficient stars. In a small temperature interval, the relation between the model parameters θ_{eff} and log g was determined in such a way that the total abundances derived from the neutral atoms were the same as those derived from the ions. Iron, chromium, titanium, and vanadium were used for that purpose and gave consistent results. The chief source of error in the final abundances is the effective temperature. If $\theta_{eff} = 0.97$, log g = 2.8, for HD 6755 and $\theta_{eff} = 1.055$, log g = 1.8, for HD 2665 are adopted, then the deficiencies of iron relative to the Sun are by factors of 11 and 37, respectively. In HD 6755 all elements are equally deficient within a factor of 2, perhaps with the exception of europium. In HD 2665 the heavy s-process elements show a deficiency with respect to iron of about a factor of 3. For the elements C, N, and O a factor of 2 or 3 additional deficiency roughly fits the observations. The result for carbon is uncertain, in addition, because of the unknown oxygen carbon ratio. The turbulent velocities, from the curves of growth, are low: 0.7 km/sec for HD 6755 and 0.6 km/sec for HD 2665. Both stars move in retrograde orbits, with large W velocities, HD 2665 toward the galactic center and HD 6755 outward. Adopting 1 solar mass for the latter star, it is found that it moves in a hyperbolic orbit. If 0.5 solar mass is adopted, the star will not escape from the Galaxy. (auth)

39743 PHOTOMETRIC DETERMINATION OF STELLAR RADII. **Gray, David F. (Univ. of Michigan, Ann Arbor. Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., 149: 317-43(Aug. 1967).**

A simple and accurate method is developed to measure stellar radii. Succinctly stated, one compares the observed absolute energy distribution with an energy distribution predicted from a model-atmosphere computation. The radius is given by the square root of the flux ratio multiplied by the distance to the star. The radius can be determined with an uncertainty of 10% or less provided the distance to the star is well known. The method has the advantages that it uses only the observable re-

gion of the spectrum, it does not depend on bolometric corrections, and it is independent of any effective temperature scale. (auth)

39744 THE COLORS OF M SUPERGIANTS. Johnson, Harold L. (Univ. of Arizona, Tucson). Astrophys. J., 149: 345-52 (Aug. 1967).

The available infrared photometric data for M supergiant stars are re-examined. It is possible to explain part of the large infrared excesses of reddened M supergiant stars as intrinsic stellar radiation; a part must still be explained in terms of interstellar extinction. If the spectral type of the Neugebauer–Martz–Leighton infrared star in Cygnus is M6 Ia, it has very large infrared excesses that appear to be reasonable compared with those found for other M supergiants. Under this interpretation, its color excess in B–V is approximately 3 mag. (auth)

39745 TRUE POLARIZATION CURVES FOR BETA LYRAE. Appenzeller, Immo; Hiltner, W. A. (Yerkes Observatory, Williams Bay, Wis. Univ. of Chicago). Astrophys. J., 149: 353-62 (Aug. 1967).

The interstellar component of the polarization of β Lyrae was determined and subtracted from new polarimetric observations obtained in the visual, blue, and ultraviolet light. The dependence of the intrinsic polarization on the phase is similar in all three colors. The amount of the intrinsic polarization is much smaller in the ultraviolet compared to the visual and blue light. A qualitative analysis of the polarization curves supports Huang's model of the β Lyrae system. (auth)

39746 A MODEL FOR THE "FILAMENTS" IN THE CYGNUS LOOP. Parker, Robert A. R. (Univ. of Wisconsin, Madison). Astrophys. J., 149: 363-72 (Aug. 1967).

Further spectrophotometric observations have been made of four "filaments," and in particular detail of one "filament," in the Cygnus Loop. The Balmer decrement for all of the "filaments" studied is 2.65, or radiative for case B. The temperatures obtained from the line ratios for [O III] and [N II] indicate that there is a stratification within individual "filaments." Collisional ionization may well be important in the high-temperature portions of the "filaments," but high-temperature thermal radiation produces the ionization of the cooler parts of the "filaments." The so-called "filaments" are probably not filaments but irregular sheets produced by the collision of the advancing shock front with the clouds of the interstellar medium, seen edge on. (auth)

39747 PHOTOELECTRIC SPECTROPHOTOMETRY OF MHα 328-116. O'Dell, C. R. (Yerkes Observatory, Williams Bay, Wis. Univ. of Chicago). Astrophys. J., 149: 373-6 (Aug. 1967).

A spectrophotometric investigation was completed on the peculiar object MHα 328-116 which has recently undergone a very large change in luminosity and spectrum. It is found that the underlying stellar continuum corresponds to that of a very hot star, in contrast to the pre-outburst M spectral type. The relative emission line strengths for [O III] lines were found to vary, as were the lower members of the Balmer series. The Balmer decrement indicates that the nebular envelope is optically thick to this line radiation, a conclusion substantiated by the relative strength of the recombination emission lines and the stellar continuum. (auth)

39748 FLUX DENSITIES OF PLANETARY NEBULAE AT 5 GHz. Hughes, M. P. (Harvard Radio Astronomy Station, Fort Davis, Tex.). Astrophys. J., 149: 377-82 (Aug. 1967).

Flux densities of twelve planetary nebulae were measured at a frequency of 5 GHz. The results were combined with flux densities reported by other workers in the range 0.195 to 8.0 GHz and are presented as spectral curves. Seven planetary nebulae, NGC 6720, 6741, 6853, 7009, 7293, 7354, and 7662, have intensity spectral indices that are essentially zero at frequencies above 0.5 GHz, indicative of thermal emission from optically thin regions. Four nebulae, NGC 7027, 6572, IC 418, and NGC 6543, have spectral indices that become positive below 3 GHz. Models that could account for the details of these spectra are briefly discussed. The reality of the non-thermal spectrum recently reported for NGC 6781 is questioned. (auth)

39749 THE EFFICIENCY OF THE BOWEN FLUORESCENT MECHANISM. Kaler, James B. (Univ. of Illinois, Urbana). Astrophys. J., 149: 383-9 (Aug. 1967).

The efficiencies of the Bowen O III fluorescent mechanism are calculated for 17 planetary nebulae from a method developed by Burgess and Seaton. The efficiency of the process decreases with increasing electron temperature, with decreasing surface brightness, and with decreasing optical depth. (auth)

39750 THERMAL INSTABILITIES AND THE FORMATION OF LOW-MASS CONDENSATIONS. Arny, Thomas (Amherst Coll., Mass.). Astrophys. J., 149: 391-4 (Aug. 1967).

The stability of a uniform density self-gravitating cloud is studied for the case of expansion and collapse. The radiation losses are explicitly included. Power series solutions for the perturbed density are developed, showing the effect of the cloud's motion on stability. For clouds starting from rest the motion has no effect on the stability criterion. The density dependence of the heating function and departures from initial thermal equilibrium are found to strongly influence the development of fragments. (auth)

39751 AN EQUILIBRIUM STATE FOR THE INTERSTELLAR GAS AND MAGNETIC FIELD. Lerche, I. (Univ. of Chicago). Astrophys. J., 149: 395-404 (Aug. 1967).

A simple periodic system is set up to demonstrate that the interstellar gas–magnetic field system, which has been shown by Parker to be unstable to a Rayleigh–Taylor type perturbation, can form an equilibrium state in which the interstellar gas is clumped discretely. It is demonstrated that in at least one instance the total energy of the clumped system is less than the total energy of the original atmosphere. It is believed that the results should be true for a much wider class of situation than the simple system for which the mathematics were performed. (auth)

39752 SPECTROSCOPIC OBSERVATIONS OF CYG X-2. Lynds, C. R. (Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., 149: L41-3 (Aug. 1967).

Some of the spectroscopic characteristics of the recently identified x-ray source Cyg X-2 are reported. Three spectrograms of the optical identification were obtained with the image-tube spectrograph on the Kitt Peak 84-inch telescope. The spectrograms were obtained on April 9, May 7, and June 9, 1967. The first two were obtained with a spectral resolution of about 10 Å, while the third was obtained at a higher dispersion and showed a resolution of about 4 Å. The occurrence of the high-excitation emission line He II λ 4686 tends to support the identification of the object as the optical counterpart of the x-ray source and suggests a comparison with the spectroscopic characteristics of the source Sco X-1. (W.D.M.)

39753 PHOTOELECTRIC SCANNER SPECTROPHOTOMETRY OF SCO X-1. Johnson, H. M.; Spinrad, H.; Taylor, B. J.; Peimbert, M. (Lockheed Missiles and Space Co., Palo Alto, Calif. Univ. of California, Berkeley). Astrophys. J., 149: L45-L50 (Aug. 1967).

On Feb. 17, March 8, and March 9, 1967, around 11 U. T., observations of the x-ray source Sco X-1 were made with the Wampler scanner at the 120-inch telescope. Calibration and extinction observations of Okis standard stars η Hya and 109 Vir, as modified by more recent data, were made on the same dates. The observations were made with the pass bands of the scanner slot centered at selected wavelengths in the presumed continuum and on certain monochromatic features of the source. (W.D.M.)

39754 REDSHIFTS OF THIRTEEN RADIO GALAXIES. Burbidge, E. M. (Univ. of California, San Diego). Astrophys. J., 149: L51-3 (Aug. 1967).

Lists of red shifts of radio galaxies have recently been published by Schmidt (1965), Landage (1966), and Wills (1967). Results are given for thirteen radio galaxies observed spectroscopically at Lick Observatory with the 120-inch telescope. The spectra were obtained during the past two years, with both the conventional prime-focus spectrograph and the Carnegie image-tube spectrograph. The lines that were measured to give the red shifts are given along with remarks on the individual objects. (W.D.M.)

39755 THE GALACTIC RADIO SOURCE W49 AT 3.4 MM. Riegel, Kurt W. (Univ. of California, Los Angeles); Epstein, Eugene E. Astrophys. J., 149: L55-8 (Aug. 1967).

The galactic radio source W49 has a flux of $54 \pm 11 \times 10^{-28}$ W/m^2/Hz at 3.4 mm. This result is consistent with the existence of very dense structure within the thermal component of W49. (auth)

39756 COMMENTS ON SHKLOVSKY'S MODEL FOR THE X-RAY SOURCE SCO XR-1. Sofia, Sabatino (Goddard Space Flight Center, New York). Astrophys. J., 149: L59-L60 (Aug. 1967).

In a recent paper, Shklovsky (1967) proposed a very elegant mechanism to explain the x-ray emission from Sco X-1. The model of the source consists of a close binary system, the primary being a neutron star and the secondary being the optical object associated with the source. The x-ray emission is then produced

by accretion on the neutron star of matter flowing from the secondary. A serious difficulty regarding the origin of such a system which could invalidate Shklovsky's analysis is discussed. (W.D.M.)

39757 ON THE ELECTRON TEMPERATURES OF H II REGIONS. Zuckerman, B.; Palmer, Patrick; Penfield, H.; Lilley, A. E. (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. J., 149: L61-4(Aug. 1967).

The 140-foot telescope of the NRAO was used to study the hydrogen emission lines 109α and 137β in three H II regions (M 17, Orion, and NGC 2024). The observations show clearly that the energy levels responsible for the radio lines are not populated according to LTE; therefore the nebular electron temperatures calculated on the assumption of LTE do not represent the temperatures of the free electrons in the nebulae. (W.D.M.)

39758 ADDITIONAL OBJECTIVE-PRISM SPECTRA OF VERY RED STARS. Pesch, Peter (Western Reserve Univ., Cleveland). Astrophys. J., 149: L65-6(Aug. 1967).

Spectral types based on low-dispersion, objective-prism spectra are presented for nine very red stars. With one rather discordant exception, these spectral types agree with recent classifications based on multi-color photometry. Two of the California Institute of Technology objects are known carbon stars. (auth)

39759 A DIFFERENT INTERPRETATION OF ρ PUPPIS. Bessell, M. S. (Australian National Univ., Canberra). Astrophys. J., 149: L67-L71(Aug. 1967).

New simultaneous spectrophotometric and spectral observations of ρ Puppis are reported. These observations show the equality of the temperature derived from Hγ and the continuum. The effective gravity of ρ Puppis determined relative to Procyon results in a mass of about 2 $M_\odot$ and indicates that ρ Puppis is probably pulsating in the first overtone. (auth)

39760 COSMIC X-RAY SOURCES IN THE 20 TO 180 keV ENERGY RANGE. Brini, D.; Ciriegi, U.; Fuligni, F.; Moretti, E.; Vespignani, G. (Univ. of Bologna). Astrophys. J., 149: 429-33(Aug. 1967).

Two X-ray sources in the energy range from 20 to 180 keV were detected in two balloon flights. They may be approximately located around R. A. 19^h, decl. 5°, and R. A. 22^h, decl. 35°, with an uncertainty of about $\pm 30^m$ in right ascension and ±10° in declination. Both fluxes are of the same order of magnitude, about 5×10^{-8} ergs cm^{-2} sec^{-1}. These could be associated with the two sources already detected at lower energies, Ser XI and Cyg X2. An association of either of them to Cyg X1 is to be excluded, while an upper limit of the flux from Cyg X1 may not be greater than a tenth of that of the other sources. Some energy spectra fitting the data are considered. A power law with an index of about 1.6 appears to give a good fit. The existence of x rays of energy of many tens of keV is pointed out. (auth)

39761 RESONANCE INSTABILITY IN A RADIALLY PULSATING STAR. Vandakurov, Yu. V. (Ioffe Inst. of Physics and Tech., Leningrad). Astrophys. J., 149: 435-8(Aug. 1967).

In a star acted on by a periodically varying perturbing force, conditions can exist for resonance self-excitation of certain free oscillations. The possibility is considered of resonance excitation of adiabatic nonradial oscillations in a radially pulsating heterogeneous spherically symmetric gravitating gaseous sphere, the amplitude of radial pulsation being assumed small. (W.D.M.)

39762 OBSERVATIONAL RESULTS OF RADIO SKY SPECTRUM. Yates, K. W.; Wielebinski, R. (Univ. of Sydney). Astrophys. J., 149: 439-40(Aug. 1967).

The results of all experiments designed to determine the background spectrum using scaled aerials were considered. Satellite results were obtained without scaled aerials. On inspection of the results quoted it was decided that direct comparisons of brightness or temperature could not be made. Instead the values of power spectral index a were compared, where a is defined by the relation brightness B varies as λ^a. These collected results are shown. The asymptotic value for the spectral index above 100 MHz appears to be a = 0.6 ± 0.1. (W.D.M.)

39763 SHORT-DURATION, NARROW-BAND SOLAR BURSTS AT 38 Mc/s. Yoh, Philip; James, Jesse C. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J., 149: 441-5(Aug. 1967).

During solar radar experiments at El Campo, Texas, several types of solar radio bursts were often observed. Among them is a type which has a very narrow band width and a duration of about 1 sec. These bursts make the detection of a solar radar echo very difficult but have very interesting characteristics. Because of the large antenna gain, 36 decibels, a large number of these short-duration narrow-band bursts have been recorded and analyzed at 38 Mc, and some of their characteristics are reported. (W.D.M.)

39764 RADAR OBSERVATIONS AND THE EXTENT OF CORONAL HEATING. Brandt, John C. (Goddard Space Flight Center, New York). Astrophys. J., 149: 447-8(Aug. 1967).

James (1966) has given the results of a radar investigation of the corona at 38 Mc. It is noted that the radar measurements appear to have delineated the extent of coronal heating, and that the result found is in good agreement with the extent of heating deduced from coronal densities. (W.D.M.)

39765 GALAXIES, QUASARS, AND THE EXPANDING UNIVERSE. Nicholson, Thomas (Hayden Planetarium, New York). Natur. Hist., 76: 36-9(Jan. 1967).

The relation of quasars to the concept of the expanding universe is discussed. Most astronomers conceive of the universe as being in a state of expansion, in which all galaxies are receding from a yet-to-be-defined center, but with the discovery of quasars the concept of an expanding universe is being questioned. The Hubble Law, stating that the red shift in the spectra of the galaxies increases uniformly with their distance, is explained. The evidence until recently seemed conclusive; the Hubble Law did seem to apply universally as far as could be observed in space. It seemed to support the concept that the universe was expanding. Since the first quasar was identified in 1963, several others of these strong sources of radio emissions have been located, and still larger red shifts have been observed for them. With these observations have come doubts concerning the validity of Hubble's Law and, thus, questions concerning the whole concept of an expanding universe. (BBB)

39766 A SURVEY OF RADIO SOURCES IN THE DECLINATION RANGES -07^0 TO 20^0 AND 40^0 TO 80^0. Gower, J. F. R.; Scott, P. F.; Wills, D. Mem. Roy. Astron. Soc., 71: 49-144 (1967).

The results of a survey using the large Cambridge interferometer at 178 Mc are presented. The methods of observation and reduction are described briefly. The catalogue lists the position and flux densities of 3624 sources having $S \geq 2 \times 10^{-26}$ $w.m^{-2}$ $(c/s)^{-1}$ at 178 Mc. (auth) (UK)

39767 ESTIMATES ON THE NEUTRON FLUX ON THE SURFACE OF THE MOON INDUCED BY SOLAR FLARES. Spergel, Martin S. (Grumman Aircraft Engineering Corp., Bethpage, N. Y.). Health Phys., 13: 845-50(Aug. 1967).

A theoretical calculation was performed on the production, by solar flare protons, of neutrons within the lunar surface, and the resulting neutron leakage flux from the lunar surface. The transport of the neutrons is approximated by a single, energy-independent, exponential attenuation function. Effective neutron attenuation length is taken as the sum of the inelastic neutron scattering length and a fraction of the elastic neutron scattering length. The resulting neutron energy distribution will necessarily have the form of the production spectrum, which is that of the nuclear evaporation model. The incident solar flare proton flux is represented by an exponential rigidity spectrum. Ionization losses for the incident solar protons are calculated from estimates of the range of the protons within the lunar surface. The lunar medium is represented by an "average" chondritic material. The resulting neutron albedo is found for three different flares and for various values of the model's parameters. Reasonable choices of these parameters lead to neutron dosage levels that are well below the NASA recommended mended maximum short mission dose levels. (auth) (UK)

39768 OBSERVATION OF THE SOLAR FLARE X-RAY EMISSION LINE SPECTRUM OF IRON FROM 1.3 TO 20 A. Neupert, W. M.; Gates, W.; Swartz, M.; Young, R. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 149: L79-L83(Aug. 1967).

Solar x-ray spectra were obtained during solar flares by OSO III (Orbiting Solar Observatory). New emission lines were observed in the spectral range from 1.3 to 20 Å and are tentatively identified as transitions in Fe XXVI through Fe XX. (auth)

39769 GRAVITATIONAL AND COSMOLOGICAL RED SHIFT FOR QUASARS. Dallaporta, N. (Inst. of Mathematical Sciences, Madras). Nature (London), 215: 586-8(Aug. 5, 1967).

It has been shown that it is possible to differentiate between the gravitational and cosmological components of the red shift of quasars by observational means. Interpretation of data, however, depends to a considerable extent on whether the source is considered to be static or expanding. Some results are given for 3C 273. The model for a quasar underlying the considerations discussed is static in the sense that possible changes occurring in its structure are considered to be sufficiently slow as not to produce any detectable effect. Most of the observed phenomenology

on several quasars, however, seems to suggest a dynamical situation, usually described as a state of expansion of the inner core, either continuous or in separate outbursts. The higher red shifts of quasars with regard to radio galaxies may be due to their excess gravitational red shift, and it might be expected that because of expansion these highly concentrated structures could gradually transform to normal radio galaxies, re-adjusting their red shift in the process to its natural cosmological proportionality with distance. The work of Barbieri is discussed. Barbieri's approach to the analysis of quasars, although apparently phenomenological and a straightforward way for gathering objective information, is still strongly dependent on the fundamental assumptions concerning the nature of the source. If it is assumed that quasars are in a static phase an important percentage of the red shift should be gravitational. If, on the other hand, quasars are expanding, then it is necessary to set an upper limit to the gravitational red shift which is practically negligible. Should quasars be structures alternatively quiescent and active, as the phenomenological distinction between quasi-stellar objects and quasi-stellar sources might indicate, substantial differences in the emission lines between these two phases should be found. This does not appear to be the case according to the present data. (UK)

39770 ORIGIN OF PLANETARY NEBULAE. Roxburgh, I. W. (Univ. of Sussex, Eng.). Nature (London), 215: 838(Aug. 19, 1967).

Statistical arguments have been advanced to indicate that all, or a large fraction of, stars with masses comparable with that of the Sun become planetary nebulae during the course of their evolution. It has also been argued that these stars are the evolutionary products of horizontal branch stars, although the mechanism for ejection of the expanding shell has remained a mystery. Details of the structure of post horizontal branch stars are available from the work of Hayashi et al., who find that as the carbon–oxygen core grows in the center of the star the luminosity increases up to 8×10^3L. This is considerably brighter than the luminosity at the time of the helium flash. As the star becomes brighter the fraction in the region of low temperatures increases, and if a sufficient fraction of the star is at temperatures below 5×10^4°K, with a consequent ratio of specific heats $\gamma < 4/3$ due to hydrogen and helium ionization, then the possibility arises that the star will be dynamically unstable. The question of the stability of a star is discussed, together with a proposed mechanism for the origin of planetary nebulae. (UK)

39771 LARGE SCALE DENSITY INHOMOGENEITIES IN THE UNIVERSE. Wilkinson, D. T.; Partridge, R. B. (Palmer Physical Lab., Princeton, N. J.). Nature (London), 215: 719(Aug. 12, 1967).

The possibility of large scale density inhomogeneities in the Universe with characteristic dimensions of the order of 10^9 parsecs has been considered, and the suggestion that quasi-stellar sources with high red-shifted spectra are not isotropically distributed has aroused interest in large inhomogeneities. The tendency of quasi-stellar sources with large Z to cluster implies that the mass of the Universe may not be homogeneously distributed on a scale of $Z \sim 1$. Although the observational status of the anisotropy of the distribution of these sources is in doubt, the present authors have obtained results which appear to set rather stringent limits on the magnitude of possible density inhomogeneities in the Universe, from measurements of the cosmic microwave background. This background originates at an epoch corresponding to a very large red shift, and provides a powerful tool for investigating the isotropy and homogeneity of the universe on the largest scale. A Dicke radiometer operating at 3.2 cm was specially designed for the experimental work. (UK)

39772 INTERNAL STRUCTURE AND ENERGY EMISSION OF JUPITER. Smoluchowski, R. (Princeton Univ., N. J.). Nature (London), 215: 691–5(Aug. 12, 1967).

The planet Jupiter emits more energy than it receives from the Sun. A theoretical study of the upper atmosphere of the planet indicated that the ratio of emitted to absorbed energy is about 4, if the albedo is 0.47, whilst recent measurements indicate a ratio of about 3. An internal energy source of nearly 10^{33} ergs/yr must therefore exist. A concentration of radioactive elements characteristic of the solar system would account only for 5×10^{-5} of the required energy. Also, the highest temperatures suggested for the interior of the planet are orders of magnitude too small to sustain exothermic nuclear reactions. The most obvious energy source appears to be the gravitational field of the planet. It can be shown that a contraction of about 0.1 cm/yr in the radius of the planet would yield the observed energy flux. The present paper examines in detail existing models of Jupiter, considers modifications to these models, and attempts to explain the observed energy flux; it also considers possible bearings on the origin of the large magnetic field of Jupiter, and on the composition of its atmosphere. (UK)

39773 WAVE-LIKE PHENOMENA IN THE INTERPLANETARY PLASMA: MARINER 2. Coleman, Paul J. Jr. (Univ. of California, Los Angeles). Planet. Space Sci., 15: 953–73(June 1967).

Some characteristics of the variations of the interplanetary magnetic field and the plasma velocity, observed during the flight of Mariner 2, are considered. First, properties of the power spectra from records of the plasma velocity and the three vector components of the field are described. Next, the properties of the cross spectra between pairs of this set of four variables are described. The variations that would be produced in the plasma velocity and the field components by hydromagnetic waves are determined from a model of a uniform, perfectly conducting, isentropic, ideal gas in a uniform magnetic field. The properties of the variations determined empirically are compared with those determined from this model. The following conditions, found to be necessary in the model, are found to be satisfied by the observed variations (1) Significant coherences were usually present between all pairs of measured variables. (2) The phase differences between each pair were independent of frequency. (3) The ratios of the power densities for each pair were independent of frequency. (4) The values of these ratios fall in the ranges established from the model. (5) The values of the phase differences were either 0° or 180°. (6) The phase differences changed by 180° when the direction of the interplanetary field changed from inward toward the Sun to outward. (auth) (UK)

39774 VARIATIONS IN THE INTERPLANETARY MAGNETIC FIELD AND SOME EFFECTS UPON SOLAR COSMIC RAYS. Coleman, Paul J. Jr. (Univ. of California, Los Angeles). Planet. Space Sci., 15: 975–95(June 1967).

The properties of the variations in the interplanetary field that were observed with the Mariner-2 magnetometer are employed in developing a model for the typical interplanetary field. Some properties of the behavior of solar protons in the model field are determined. It is shown that protons with energies less than 1 MeV would travel adiabatically throughout the solar system, protons with energies in the range 1 to 100 MeV would first encounter efficient scattering at heliocentric ranges beyond 1 A.U., protons with energies in the range 100 MeV to 1 BeV would encounter efficient scattering at ranges near 1 A.U., and protons with energies greater than 1 BeV would first encounter efficient scattering at ranges less than 1 A.U. It is argued that various properties of solar-proton events may be accounted for by this model. Nonrelativistic solar-flare electrons, however, would travel adiabatically throughout interplanetary space. Using the Mariner-2 data it is shown that a good deal of the observed spread in the directions of travel of solar protons in the interplanetary field at the onset of an event is probably due to the variations in the orientation of the field rather than to a spread in particle pitch angles. (auth) (UK)

39775 IS A QUASAR NUCLEUS A STAR CLUSTER OR A SINGLE BODY? Gudzenko, L. I.; Ozernoy, L. M.; Chertoprud, V. E. (Lebedev Inst. of Physics, Moscow). Nature (London), 215: 605–6(Aug. 5, 1967).

It has been suggested incorrectly that the optical variability of the quasar 3C 273 is compatible with a model which is a complex of several sources of the same type—for example, a star cluster within which there are independent occasional collisions and possibly also flash-like supernovae. The statistical properties of the optical variability of 3C 273 are such as to suggest that the separate parts of a quasar nucleus interact, and a quasar nucleus is in the limit a single body. The conflicting views with regard to the interpretation of quasar radiation by the superposition of independent occasional events can be treated by mathematical statistics, and this treatment is outlined. It is concluded that the optical variability of 3C 273 cannot be interpreted as a result of the superposition of independent random flashes in a compact star cluster. There are serious energy and cosmogonic objections to any hypothesis of a quasar nucleus as a compact star cluster. The unacceptability of the model of a compact star cluster as an energy source can be shown by an analogy between quasars and radio galaxies, Seyfert galaxies, and the nuclei of common galaxies. The assumption that the radiation source of the quasar nucleus is, in the limiting case, a single body finds direct verification in the statistical analysis of light variation of 3C 273. (UK)

39776 RADIO EMISSION FROM THE SOURCES 3C 225 AND 3C 267. Macdonald, G. H.; Kenderdine, S. (Cavendish Lab., Cambridge, Eng.). Nature (London), 215: 603–4(Aug. 5, 1967).

Observations of the two radio sources, which are of large angular extent and each containing a compact component without any apparent associated blue object, despite the fact that the large angular extent implies a moderate distance, are described. Unless the two components of each source represent a chance association, the observations suggest that the intense optical emission has been of limited intensity or duration. The observations were made with

the one-mile radio telescope at 408 and 1407 Mc, and the maps obtained are reproduced, together with plots of flux densities. With regard to 3C 225, there appears to be good evidence for the existence of a component of very small angular size, providing 30 to 40% of the emission. The presence of such a compact source suggests that at low frequencies the effects of synchrotron self-absorption might be apparent. With regard to 3C 267, observations suggest that about 30% of the radiation must originate in a region of less than 0.2 sec arc, and the compact source is expected to show synchrotron self-absorption. The absence of any blue object which can reasonably be associated with either radio source may imply a difference in lifetime of the optical and radio emitting regions. (UK)

39777 MAGNETISM AND THE COSMOS. NATO Advanced Study Institute on Planetary and Stellar Magnetism in the Departments of Physics and Mathematics, University of Newcastle upon Tyne, April 1965. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967. 448p. $27.50.

Papers are presented on geomagnetism, stellar magnetism, solar magnetism, planetary magnetism, and solar system magnetic fields. Separate abstracts were prepared for 26 of the papers. (W.D.M.)

For abstracts of individual papers see: 39778–39790, 39840, 39858, 39859, 39885–39893, and 40012.

39778 SOLAR EMISSIONS AND MAGNETIC-AURORAL STORMS ON THE EARTH. Chapman, Sydney (Univ. of Alaska, College. High Altitude Observatory, Boulder, Colo.). pp 3-28 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Topics discussed include solar–terrestrial relations, magnetic storm morphology (prediction of the limited magnetosphere), the ring current, interplanetary matter and fields, polar magnetic and auroral substorms, association between the ring current and the polar substorms, uncharged component of the solar gas, asymmetry of the ring current, growth of the ring current before enhanced compression of the magnetosphere, rates of recovery of H from magnetic storm decreases, and latitudes attained by auroras during great storms. (W.D.M.)

39779 ZEEMAN EFFECT. Hindmarsh, W. R. (Univ. of Newcastle upon Tyne, Eng.). pp 151-5 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Knowledge of the magnetic fields of stars is gained by the study of the Zeeman effect in the lines of stellar spectra. The theory of the Zeeman effect is described with particular attention to those parts of the theory which are often omitted in elemeatary text books. A description is given of the classical theory of the Zeeman effect and the quantum theory of the Zeeman effect is summarized. (W.D.M.)

39780 SPECTRA OF THE MAGNETIC STARS. Hack, Margherita (Astronomical Observatory, Trieste, Italy). pp 163-78 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Stellar magnetic fields are probably present in all types of stars. However, only coherent magnetic fields of one predominant polarity give observable effects on stellar spectra, like the Zeeman splittings of the lines. About 90% of the stars which have measurable magnetic fields belong to spectral types ranging from B5 to F5 (mainly Ap and Am). The peculiarities of the Ap- and Am-type stars are discussed. (W.D.M.)

39781 VARIATIONS OF STELLAR MAGNETIC FIELDS AND THE OBLIQUE ROTATOR HYPOTHESIS. Boehm-Vitense, Erika (Univ., Heidelberg). pp 179-88 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

One possible explanation for the large periodic changes of the magnetic field in the α variables is the oblique rotator hypothesis. It explains easily the observed rapid changes of the magnetic field. So far, quantitative investigations from a general point of view have been made only by Stibbs (1950) for a spherically symmetric star with a dipole field. The aim of this investigation is to find out how the result of Stibbs will be altered if less-restricted assumptions are used. Cylindrical symmetry around the magnetic axis for all physical values is assumed. (W.D.M.)

39782 ROTATION OF MAGNETIC STARS. Steinitz, R. (Hebrew Univ., Jerusalem). pp 189-93 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Some recent evidence in support of the oblique rotator model and against the oscillator model is presented. (W.D.M.)

39783 THEORIES OF STELLAR MAGNETISM. Mestel, L. (Cambridge Univ., Eng.). pp 194-208 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Three theories of the origin of stellar magnetism are discussed. The fossil theory regards a stellar field as a slowly decaying relic of a primeval field present in the gas from which the star formed. Magnetic variability is explained by the oblique rotator model. The dynamo theory takes the solar cycle as the prototype of stellar magnetic variability in general. The battery process is the third theory, in which toroidal magnetic flux is generated spontaneously in (initially nonmagnetic) rotating stars. (W.D.M.)

39784 FINE STRUCTURE OF SOLAR MAGNETIC FIELDS. Severni, A. (Crimean Astrophysical Observatory, Partizanskoe, USSR). pp 211-24 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

The phenomenon of the fine structure of emission at active regions on the Sun and the fine inhomogeneous structure of the solar atmosphere in general are discussed briefly. Observational evidence for the fine structure of solar magnetic fields is described in detail. (W.D.M.)

39785 SUNSPOT MAGNETIC FIELDS: DETERMINATION OF THE CONFIGURATION OF THE LINES OF FORCE. Adam, M. G. (Oxford Univ.). pp 225-32 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

The measurement of the magnetic field strength over the region of a sunspot is a comparatively straight forward matter. But the question of the direction of the magnetic vector at any point on the solar surface has, until recently, received much less attention, and as yet there is considerable disagreement between the results obtained by different observers. A discussion is presented on the technical aspects of this observational problem, because the answers are becoming increasingly important in the hydromagnetics of individual sunspots, and also for theories of the magnetic cycle of the Sun as a whole. (W.D.M.)

39786 SOLAR FLARES AND MAGNETIC FIELDS. Reid, John H. (Dublin Inst. for Advanced Studies). pp 233-9 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Before postulating a duplex mechanism for particle flares, a review is given on the observational evidence for the close relationship between solar flares and the magnetic fields of the regions in which they occur. (W.D.M.)

39787 MEASUREMENT OF RESONANCE POLARIZATION IN THE CHROMOSPHERE OF THE SUN AND ITS GENERAL MAGNETIC FIELD. Brueckner, G. (Univ., Goettingen, Ger.). pp 240-5 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Because of the high instrumental polarization of coelostats it is very difficult to measure small linear polarization with them. Therefore a Gregory–Coudé telescope with an aperture of 45 cm was used. A rotating half-wave plate in front of the slit of a 10-m Echelle spectrograph was the analyzer. The diameter of the field observed was 3.5″. The solar image around the measuring spot was observed through an Hα interference filter. Results are given for the northern and southern hemispheres. (W.D.M.)

39788 SOLAR MAGNETIC FIELDS. Alfven, Hannes (Royal Inst. of Tech., Stockholm). pp 246-61 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Very little is known with certainty about the general magnetic field of the Sun. Interpretation of the observational material is discussed in terms of the longitudinal Zeeman effect, alternative interpretation of the Zeeman effect variation, inhomogeneous model, transverse Zeeman effect and currents in the solar atmosphere, description of the electromagnetic state by current mapping, filamentary currents in force-free magnetic fields, and regularity of solar activity. (W.D.M.)

39789 CONCENTRATION OF MAGNETIC FIELDS BY CONVECTION IN THE SUN. Weiss, N. O. (Cambridge Univ., Eng.).

pp 262-8 of Magnetism and the Cosmos. Hindmarsh, W.R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Throughout the photosphere and the convection zone of the Sun, magnetic fields are associated with turbulent convective eddies. The magnetic Reynolds number R_m is very high: $R_m \sim 10^{10}$ in the deep convective zone, $R_m \sim 10^6$ in the photosphere. The fields are therefore distorted and amplified by the motion. (W.D.M.)

39790 GEOMAGNETIC ACTIVITY AROUND CONJUNCTION AND OPPOSITION OF PLANETS. Houtgast, J.; van Sluiters, A. (Univ., Utrecht). pp 399-401 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

A decrease in the values of the International Daily Magnetic Character figures was found during a period of about eight days around inferior conjunctions of Venus. The dip is pronounced in years of low solar activity and for conjunctions in which Venus passes the Sun within a latitude of 5°. The effect was considered to be the consequence of a screening effect on solar particles, thus indicating that Venus had a magnetic field. The effect appeared to be absent for Mercury. When the same method was applied to periods around the oppositions of Mars and Jupiter, no effect was found for Mars, but in the case of Jupiter a rather significant dip was found for ten days centered around the opposition date. (W.D.M.)

39791 BALLOON X-RAY ASTRONOMY. Peterson, L. E.; Jerde, R. L.; Jacobson, A. S. (Univ. of California, San Diego, La Jolla). New York, American Institute of Aeronautics and Astronautics, 1966, Preprint No. 66-1015, 9p., $1.50. (CONF-661124-4). DTIE.

From 3rd AIAA Annual Meeting, Boston.

The discovery of x rays from cosmic sources has opened new possibilities in space astronomy and high-energy astrophysics. Rocket observations provide position, size, and spectral measurements over the range about 1 to 20 keV. Atmospheric absorption effects are small enough to allow measurements above 20 keV to be made at extreme balloon altitudes. Here the weak intensities may be compensated for by an increased observing time, providing a detector of sufficiently low background and small collimation angle is used. Detection systems usually employ large area scintillation counters, with collimation of either passive materials or of the active anticoincidence type. Suspected x-ray sources may be either scanned, allowed to transit through the instrument aperture, or tracked with a servo-controlled pointing system. In the system used at UCSD, events from the detector, which is collimated with an anti-coincidence shield of scintillation material, are energy analyzed into 128 channels. The data are transmitted on a PCM/FM/FM telemetry system in a format suitable for computer analysis. Balloon observations have provided the best information relative to the detailed spectra of the emitted x rays. The data when correlated with position, size, and optical and/or radio identification, permit a determination of the origin of the x rays and the physical state of emitting region. Only the strongest source, Scorpius XR-1, and the very familiar Crab Nebula have been studied in detail. Although these are of galactic origin, x rays from extra-galactic objects have also been tentatively identified. In addition, there exists a general diffuse x-ray component apparently originating from the Universe as a whole. (auth)

39792 MACRO AND MICRO STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD. Burlaga, Leonard F.; Ness, Norman F. (Goddard Space Flight Center, Greenbelt, Md.). 16p. (CONF-670628-1). DTIE.

From 10th International Conference on Cosmic Rays, Calgary, Alberta, Canada.

Detailed measurements of the interplanetary magnetic field have been performed with an accuracy of $\pm.25\gamma$ on the Pioneer 6 satellite beginning towards the end of solar rotation 1811 and continuing into solar rotation 1817 in mid 1966. A non-stationary pattern to the sector structure has been observed. The polarity autocorrelation function shows a peak at 29 days. A radial gradient of the interplanetary magnetic field between 0.81 and 1.0 AU has been observed in agreement with Parker's model. The average magnitude of the component perpendicular to the ecliptic plane was zero. The direction of the interplanetary magnetic field was frequently observed to change by $\omega \geq 30°$ in less than 30 seconds as the field was carried past the spacecraft. In most cases the magnetic field intensity did not change significantly across the discontinuity. The distribution of these discontinuities can be represented by the equation $dN/d\omega \approx A[-(\omega/75°)^2]$. Several times, a large, discontinuous change in the field direction was accompanied by a dip in the field intensity. In each case, the measured minimum magnetic field intensity agreed with value which was calculated from the hypothesis that the dip was the result of magnetic field annihilation. At least two of these "D sheets" appear to be transitional regions associated with tangential discontinuities. (auth)

Atomic and Molecular Physics

Refer also to abstracts 39714, 39736–39738, and 39971.

39793 (DESY-67/23) KOHAERENTE BREMSSTRAHLUNG UND PAARBILDUNG AN DIAMANT-EINKRISTALLEN. (Coherent Bremsstrahlung and Pair Production on Diamond Single Crystals). Lutz, Gerhard (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). July 1967. 82p. (In German). Dep.

Quantum Electrodynamics predicts modifications of the bremsstrahlung and pair-production cross sections with respect to the cross sections for single atoms when crystal targets are used. In addition, the bremsstrahlung photons should be linearly polarized, and the pair-production cross section should depend on the linear polarization of the photons. All these effects were quantitatively proved by experiment and compared with the theory. A theory of the influences effects of target thickness and collimation on the bremsstrahlung spectrum was developed in order to make possible a comparison of the experimental results with theory. The experimental results obtained for bremsstrahlung and pair-production cross sections are in agreement with theory. The polarization of bremsstrahlung was measured using the dependence of the pair-production cross section on photon polarization. Good agreement with theory is found for various photon energies and polarization degrees; thus the polarization of bremsstrahlung as well as the polarization dependence of the pair-production cross section are shown to have been correctly predicted by theory. A method was found of producing photons having a very high degree of linear polarization. (auth)

39794 (IS-T-137) STIMULATED COMPTON SCATTERING OF ELECTRONS BY A LASER BEAM. Roskos, Roland Rufus (Ames Lab., Iowa). Nov. 1966. Contract W-7405-eng-82. 86p. Dep. CFSTI.

Thesis.

Stimulated Compton scattering has been treated in terms of an interaction of an electron plane wave with a perturbing potential corresponding to the standing light wave to obtain a stationary state solution to the Schroedinger equation. Probabilities of electron deflection were derived for various laboratory conditions with emphasis placed on electron beam orientation and coherence properties of the laser. A new electron-diffraction unit has been designed for the observation of stimulated Compton scattering. Giant pulses in the cavity of a Q-switched ruby laser served to diffract 1640-volt electrons. The small scattering angles were measured by scanning the electrons past a slit of a scintillator detector. Theoretical demands on design of apparatus are discussed, experimental difficulties are listed, and the limitations of the apparatus are described. Numerous experiments were completed over the period of several months when the laser generated high powers. Many deflection events were obtained at both positive and negative scattering angles which were consistent with expectations for stimulated Compton scattering. Some experiments were attempted in which the electron deflection probabilities were observed as functions of electron beam orientation and laser power. Qualitative results indicated that measurable electron deflections occurred only when the electron beam intersected intense standing light wave planes at the Bragg angle. The observed deflections also required high laser powers. All experimental observations seemed consistent with developed theory within the broad limits of experimental error. A critical test of theoretical expressions, however, was not possible because the complex distribution of energy and divergence of the laser radiation were not fully characterized. Good evidence has been gathered to verify the existence of stimulated Compton scattering. (auth)

39795 (LA-3002(Suppl.2)) STATUS REPORT ON OPACITY CALCULATIONS. Huebner, Walter F.; Generosa, John; Harris, Richard (Los Alamos Scientific Lab., N. Mex.). May 31, 1967. Contract W-7405-eng-36. 66p. Dep. CFSTI.

The results of a survey in the opacity field have been compiled and are presented here categorized according to the various phases of an opacity calculation. The categories include: energy levels, wave functions, electronic occupation, bound–free transitions, free–free transitions, bound–bound transitions, scattering, molecular transitions and complete opacity calculations. A list of scientists recently active in one or more of these fields is included. (auth)

39796 (ORNL-AMPIC-1) BIBLIOGRAPHY OF ATOMIC AND MOLECULAR PROCESSES FOR 1963. Barnett, C. F.; Ray, J. A.;

Thompson, J. C.; McDaniel, E. W. (Oak Ridge National Lab., Tenn.). July 1965. Contract W-7405-eng-26. 133p. Dep. CFSTI.

This annotated bibliography contains references of interest to atomic and molecular processes research. Bibliographical sources consisted of thirty technical journals and three abstract journals. The references are classified into twelve categories and the material in each is listed alphabetically by authors. (auth)

39797 (SC-DC-67-2012) CHANNELING IN QUARTZ. Sattler, A. R.; Brice, D. K. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. Contract AT(29-1)-789. 14p. (CONF-670924-1). Dep. CFSTI.

From International Conference on Solid State Physics Research with Accelerators, Upton, N. Y.

The energy loss of Mev hydrogen and helium ions in single-crystal quartz is described. Channeling results are presented for particle incidence along the a, a*, and c axes (x, y, and z axes, respectively) in swept synthetic quartz. (M.O.W.)

39798 (UCRL-70525) COMPILATION OF X-RAY CROSS SECTIONS. McMaster, W. H. (California Univ., Livermore. Lawrence Radiation Lab.). June 29, 1967. Contract W-7405-eng-48. 15p. (CONF-670723-1). Dep. CFSTI.

From Defense Atomic Support Agency Effects Conference, Columbus, Ohio.

A compilation of x-ray cross sections has been made in the range 1 keV to 1 MeV. To obtain this compilation, a survey of the existing experimental x-ray total cross section was made. Form factors available in the literature were used to compute the scattering cross sections. Values for the cross sections are illustrated for barns/atom and for cm^2/g. (W.D.M.)

39799 (AD-653510) IONIC-MOLECULAR REACTIONS OF HYDROGEN WITH NOBLE GASES. Tikhomirov, M. V.; Spezhakova, G. E.; Tunitskii, N. N. Translated from Paper Presented at Mezhdunar. Simp. Svostvam Primen. Nizkotemp. Plazmy XX-om, Mezhdunar. Kongr. Teor. Prikl. Khim., Moscow, 1965. 10p. (FTD-MT-65-547; CONF-650723-3). CFSTI.

The dependence of the yield of HeH^+ and HeD^+ ions on the energy of ionizing electrons in ionic–molecular reactions is investigated. It is shown that the relative yield of HeH^+ ions decreases in the electron energy field from 25 to 17 eV, and the ratio HeH^+/HeD^+ is constant and approximately equal to 0.8 when the energy changes from 70 to 25 eV. The dependence of a cross section on the vibrational state of an H_2^+ ion is investigated in accordance with O. B. Firsov's ionic–molecular reaction theory. It is shown that an intermediate complex of this reaction decomposes into initial products with great probability, which decreases the HeH^+ yield. The experimental dependence of the HeH^+ yield on electron energy agrees with the theory. (auth)

39800 ELECTRON SLOWING-DOWN SPECTRA IN ALUMINUM AND COPPER. Oda, Nobuo; Nishimura, Fumio (Tokyo Inst. of Tech.). Tokyo Kogyo Daigaku Gakuho, No. 77, 41-60 (Mar. 1967).

The total electron slowing-down spectrum was evaluated assuming the modified continuous slowing-down model, taking into consideration the accumulation of δ rays. As for the source of δ rays, knockon electrons are taken into consideration. Bremsstrahlung losses are grouped together into the continuous slowing-down process. Present results are compared with the results obtained by a method developed by Spencer and Fano. It was confirmed that the present treatment gives fairly good results in spite of its much simplified form than that of Spencer and Fano. Tabulations of the integrated total electron densities are given for aluminum and copper for source energies of initial electrons ranging from 2048 down to 0.5 keV. The lower limit of initial energy of δ rays is taken to be 0.125 keV. From the tabulated results, the total electron slowing-down spectrum for any "cut-off" energy which is larger than 0.125 keV can be derived by a simple manner. (auth)

39801 ELECTRON EMISSION ENERGY SPECTRUM OF A KCl SINGLE CRYSTAL BOMBARDED WITH HELIUM IONS. Kondrashev, A. I.; Petrov, N. N. (Leningrad Polytechnic Inst.). Dokl. Akad. Nauk SSSR, 173: 67-9(Mar.-Apr. 1967). (In Russian).

A study was made of the energy distribution of electrons knocked out from a KCl single crystal by He^+ ions directed perpendicularly to the (100) face. Distribution curves were obtained by the method of the retarding field. The curves representing the delay of emission current from KCl crystal bombarded with He^+ ions of E_0 = 20, 40, 100, 200, and 400 eV and those representing the energy spectra of electrons show that when the ion energy increases, the number of slow electrons ($E \lesssim 3$ eV) sharply increases. At the same time, the number of fast electrons ($E \gtrsim 4$ eV) weakly depends on E_0. Assuming that these electrons appear due to potential-induced electron emission, the value of W—the minimum energy necessary to remove the electron from a solid body—can be evaluated from the maximum energy of electrons E_{max}. For the minimum kinetic energy of ions E_0 = 20 eV two values for E_{max} were obtained: $E'_{max} = 9 \pm 1$ eV and $E''_{max} = 7.5 \pm 1$ eV. Assuming that the energy levels of the helium atom do not shift when the atom approaches the crystal surface, then $W = (7.8 \pm 0.5)$ eV and $W = (8.5 \pm 0.5)$ eV, applying E'_{max} and E''_{max}, respectively. Because of the possibility that the potential of ionization of the helium atom near the crystal surface can decrease, the obtained values of W can be slightly elevated. These values are in good agreement with the literature data on the value W for KCl crystals. (ATD)

39802 INFLUENCE OF THE FORM OF THE ELECTRODES AND POLES OF QUADRUPOLE LENSES ON THE QUALITY OF THE IMAGE PRODUCED BY THEM. Ovsyannikova, L. P.; Yavor, S. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). Dokl. Akad. Nauk SSSR, 173: 76-8(Mar.-Apr. 1967). (In Russian).

Since the desired constant field-intensity gradient is not attainable in real quadrupole lenses, the influence of the variation of the field gradient on the quality of the image produced by a two-dimensional quadrupole lens is considered. Since the deviations of the field from linearity are given by expansion terms of sixth order and above, fifth-order aberrations for a beam of charged particles emerging from a point situated on the axis are calculated. Analytic expressions are derived for the aberration coefficients of a linear image produced by a combined lens made up of electric and magnetic quadrupoles, in which the symmetry plane of the electric field coincides with the antisymmetry plane of the magnetic field. The aberration coefficients are tabulated. The results of the calculations make it possible to estimate the permissible linearity in each concrete design case. (ATD)

39803 DEPENDENCE OF THE DEGREE OF NEUTRON POLARIZATION ON THE MATERIAL PROPERTIES AND TRANSMISSIVITY. Starodubtsev, S. V.; Khrushchev, B. I.; Shadmanov, R. Sh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 3, 67-9(1967). (In Russian).

The polarization of neutrons by single passage through ferromagnetic material was studied using various steels. A neutron beam from a horizontal reactor channel was used, along with a 10- to 12-cm beryllium filter. Results are presented both for unfiltered and filtered beams. (R.V.J.)

39804 CYLINDRICAL CONDENSER METHOD FOR STUDYING ENERGY DISTRIBUTION OF ELECTRONS EMITTED FROM MOLYBDENUM BOMBARDED BY IONS AND INERT GAS ATOMS. Arifov, U. A.; Rakhimov, R. R.; Dzhurakulov, Kh.; Karetnikova, N. A. (Physical-Technical Inst., Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 3, 40-4(1967). (In Russian).

Energy distributions of electrons emitted from molybdenum bombarded by ion beams and helium, neon, and argon atoms at energies from 0.5 to 5.0 keV were studied by the means of a cylindrical condenser with an automatically recording oscillograph. It is shown that at the identical rate of bombardment the kinetic emission potential is comparatively stronger in the case of bombardment with atoms having more complex electron shells. (R.V.J.)

39805 METHOD FOR DEVELOPING ASYMPTOTICS IN A PROBLEM OF INDUCED EMISSION OF ATOMS MOVING IN A STRONG ELECTROMAGNETIC FIELD. Turovtseva, L. S. Zh. Vychisl. Mat. Mat. Fiz., 6: 1108-14(Nov.-Dec. 1966). (In Russian).

The two-level approximation problem of interactions between a moving atom and an electromagnetic field is reduced to the first-order solution of two linear differential equations for the amplitude probabilities $a_1(t)$ and $a_2(t)$. (R.V.J.)

39806 ELECTRONIC ABSORPTION SPECTRUM OF URANYL SULFATE. Narasimham, K. V.; Garg, C. L. (Defence Science Lab., Delhi). Indian J. Pure Appl. Phys., 5: 128-31(Apr. 1967).

The electronic absorption spectra of the uranyl sulfate ($UO_2SO_4 \cdot 3H_2O$) were studied with powder samples of the compound at liquid air temperature and in solution of the compound at room temperature. The absorption bands were analyzed as due to four electronic transitions from a common ground state to the different excited states corresponding to four systems with (0,0) bands at 20561, 21587, 22923, and 26600 cm^{-1}. Fundamentals of the uranyl frequencies, crystal lattice frequencies, and sulfate ion frequencies obtained from the analysis were correlated with those obtained from the analysis of fluorescence, infrared and Raman spectra and satisfactory agreement was observed between the various fundamentals. (auth)

39807 SCATTERING FACTOR IN NUCLEAR EMULSIONS. Sood, P. M.; Ahuja, S. D. M. (Panjab Univ., Chandigarh, India). Indian J. Pure Appl. Phys., 5: 132-4(Apr. 1967).

Variation of scattering factor K with cell length was calculated for standard G5 nuclear emulsions using five theoretical expressions and compared with the variation estimated experimentally by the Y-displacement method for cell lengths of 4, 6, and 8 cm and by the Fowler's coordinate method for cell lengths of 4 mm to 4 cm. Values of K obtained for different cell lengths by both these independent experimental methods agree closely but are lower than the theoretical values by about 15 to 25%. (auth)

39808 THE DRIFT VELOCITY OF POTASSIUM IONS IN HYDROGEN AT 293°K. Elford, M. T. (Australian National Univ., Canberra). Aust. J. Phys., 20: 471-5(Aug. 1967).

The drift velocity of K ions in hydrogen was measured at 293°K, at gas pressures of 1, 2, 10, 20, and 50 torr, and over a range of values of E/N from 0.61×10^{-17} to 9.1×10^{-16} V cm^2. The measurements were made in a drift tube with no provision for direct mass identification. The results are tabulated and compared with results of other investigators. In general, agreement with other data is good. (A.G.W.)

39809 MOMENTUM TRANSFER CROSS SECTION FOR ELECTRONS IN HELIUM. Crompton, R. W.; Elford, M. T.; Jory, R. L. (Australian National Univ., Canberra). Aust. J. Phys., 20: 369-400(Aug. 1967).

Measurements of the drift velocity, the ratio of diffusion coefficient to mobility, and the magnetic drift velocity for electrons in helium have been made at 293°K in the range $1.8 \times 10^{-19} < E/N < 3 \times 10^{-17}$ V cm^2. From an analysis of the drift velocity data, an energy-dependent momentum-transfer cross section has been derived for which an error of less than ±2% is claimed over the central portion of the energy range. The cross section agrees with the theoretical cross section of La Bahn and Callaway to within 2% over the whole energy range. The agreement with the cross section derived by a number of procedures from the total elastic scattering cross section measured by Golden and Bandel is less satisfactory. The drift data are sufficiently accurate to enable a search to be made for the effects of fine structure in the cross section at low energy. The results do not support the existence of such structure. (auth)

39810 POSITRON ANNIHILATION IN LITHIUM HYDRIDE. Gainotti, A.; Ghezzi, C.; Manfredi, M.; Zecchina, L. (Univ., Parma, Italy). Phys. Lett., 25A: 316-18(Aug. 28, 1967).

Results of positron decay spectra in LiH and preliminary data of positron annihilation in NaH, TiH_2, ZrH_2 are reported. (auth)

39811 PHOTOIONIZATION OF ATOMIC NITROGEN. Comes, F. J.; Elzer, A. (Univ., Bonn). Phys. Lett., 25A: 334-5(Aug. 28, 1967).

The photoionization of atomic nitrogen has been measured using a cross beam technique. (auth)

39812 ECKART-TYPE WAVE FUNCTIONS FOR EXCITED STATES OF TWO-ELECTRON ATOMS. Chong, D. P. (Univ. of British Columbia, Vancouver). Mol. Phys., 12: 599-600(Aug. 1967).

It is stated that Eckart-type wave functions should be good simple approximate representations of the lowest (bound) excited state of each symmetry for all two-electron atoms. The present paper gives the results of calculations of these wave functions for the lowest $^{1,3}P$, $^{1,3}D$, and $^{1,3}F$ states of He, Li^+, Be^{2+}, and B^{3+}, employing double precision on an IBM 7040 computer. Ionisation potentials are also tabulated. (auth)

39813 A MEASUREMENT OF THE CROSS SECTION FOR DETACHMENT OF ELECTRONS FROM H^- BY ELECTRON IMPACT. Dance, D. F.; Harrison, M. F. A.; Rundel, R. D. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Proc. Roy. Soc. (London), Ser. A, 299: 525-37(July 25, 1967).

A crossed-beam method was used to measure the cross section for the production of neutral particles in single collisions of electrons with H^- ions at incident electron energies from 9 to 500 eV. The measured cross section reached a maximum of 50 Å^2 at an energy of 14 eV, and may be represented by the function $Q = [1 - (1.6/(E \log_{10} E)^{\frac{1}{2}})](950/E)\log_{10}(E/0.92)$, where the cross-section Q is in units of Å^2 and the incident electron energy E in units of electron volts. The magnitude and functional dependence of the cross section agree well with theoretical calculations based on the Bethe–Born approximation at energies above 20 eV. (auth) (UK)

39814 POLARIZABILITY OF THE H_2^+ ION. Adamov, M. N.; Rebane, T. K.; Evarestov, R. A. Opt. Spectrosc. (USSR) (Engl. Transl.), 22: 389-91(May 1967).

Translated from Opt. Spektrosk., 22: 709-13(May 1967).

Upper and lower limits of the electronic polarizability of the H_2^+ ion have been calculated using variational methods of perturbation theory. Utilizing the very precise, unperturbed wavefunction of James, calculations based upon a two-parameter variation have shown that the longitudinal and transverse polarizabilities lie respectively within the limits: $5.173 \leq \alpha_{||} \leq 5.271$ at. units, and $1.847 \leq \alpha_{\perp} \leq 1.850$ at. units. (auth)

39815 INVESTIGATION OF THE EXCITATION CROSS SECTION OF SOME INERT GASES NEAR THE THRESHOLD. Gavallas, L. A. (Leningrad Inst. of Precision Mechanics and Optics). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 142-4(1967). (In Russian).

The experimental apparatus used is illustrated. Electrons emitted by the cathode are accelerated by two coaxial cathodes which have an intermediate annular slot. Through this slot the electrons enter the "collision space," a space between the anode and the equipotential grid, which is free of any electric field. The geometry of the electrodes is such that the electrons, flying directly from the cathode, cannot fall on the second anode. Based on experimental data obtained with this apparatus, a figure shows the dependence of the excitation cross section for helium, neon, and argon, on the energy of the incident electrons. These data are said to be more precise than previously published data in the literature. (ATD)

39816 NEWLY IDENTIFIED LINES IN THE Ne I ISOELECTRONIC SEQUENCES. Feldman, U.; Cohen, L. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 149: 265-7(Aug. 1967).

Using a grazing-incidence spectrometer and a low-inductance, 14-μF, 12 to 17-kV spark source, the spectra of Sc XII, Ti XIII, and V XIV were observed. The lines were identified as arising from transitions between the ground level $2s^2\ 2p^6\ ^1S_0$ and the following electronic configurations: $2s\ 2p^6\ 3p$, and $2s^2\ 2p^5\ 4s$, 4d, 5d. The transitions of the type $2s^2\ 2p^6 - 2s^2\ 2p^5\ 4d$ were observed also in Co XVIII, Ni XIX, and Cu XX. (auth)

39817 THE INTEGRAL STOPPING POWER OF LIQUID HYDROCARBONS FOR 5.3-MeV α PARTICLES. Aniansson, Gunnar (Royal Inst. of Tech., Stockholm). Trans. Roy. Inst. Technol., Stockholm, No. 178, 35p(1961).

The ranges in 22 different hydrocarbon compounds of α particles under deceleration from 5.3 MeV to 25 keV energy were measured with high accuracy. In the absence of even approximate data on stopping power for 25 keV α particles, the extension of the ranges to zero energy was made using data obtained incidentally during the range measurements. An error of less than 0.1 μ was obtained. Of much higher accuracy were the relative stopping powers obtained. It was found that the normal paraffins conform to the additivity rule for the stopping power with a relative variance of 0.023% including the experimental errors. The 5 hexane isomers exhibited a relative variance of 0.065% from their average and isooctane (2,2,4-trimethylpentane) differed from n-octane by 0.1%. The effect of branching of the paraffin chain thus was small. A slight systematic decrease in stopping power with density was indicated. Increments in the stopping power due to single double bonds were established, and a great difference was found between the increments in 1-hexane and 2-pentene compared with that in cyclopentene. The benzene homologs differed in stopping power by amounts that agreed with those predicted using the stopping power of the CH_2 group obtained in measurements on the paraffins and cyclohexane. The stopping power of benzene was 2.2 ± 0.1% larger than the value predicted from the paraffin values on the basis of additivity. It was shown that serious ambiguities are inherent in the existing theories on the density effect, the abolition of which is a prerequisite for satisfactory treatment of nonrelativistic particle stopping power measurements. The results were compared with those of high-energy proton investigations. The relative accuracies in the two measurements were found to be about the same despite the enormous difference in the order of magnitude of the ranges measured. (BBB)

39818 ADDITIONAL RESONANCE LINES OF HIGHLY IONIZED SULFUR, CHLORINE, ARGON, AND POTASSIUM. Deutschman, William A.; House, Lewis L. (High Altitude Observatory, Boulder, Colo.). Astrophys. J., 149: 451-2(Aug. 1967).

Recent modifications to the High Altitude Observatory's θ-pinch vacuum uv light source have extended the number of stages of ionization and also the number of elements that can be used for study. The S, Cl, and Ar spectra reported were exposed with 1μ of impurity gas added to as few as 25μ of H. Excitation of nonvolatile compounds or elements, such as K and Ca, was accomplished by the introduction of small amounts of the material

in solid form. Spectra were recorded on a Hinterreger 2-m grazing-incidence rocket spectrograph using Kodak SWR plates. (W.D.M.)

39819 THE FREE–FREE TRANSITIONS OF He^- AT THRESHOLD. John, T. L. (Univ. Coll. of South Wales and Monmouthshire, Cardiff). Astrophys. J., 149: 449-50(Aug. 1967).

There has been particular interest recently in He^- as a source of continuous absorption in stellar atmospheres. Calculations of the free–free transitions of He^- have been made by Somerville (1965) and McDowell, Williamson, and Myerscough (1966). However, the approximations used by these authors introduce inaccuracies at threshold, and the effect is briefly discussed in this note. (W.D.M.)

39820 RECURSIVE EVALUATION OF SOME ATOMIC INTEGRALS. Sack, R. A.; Roothaan, C. C. J.; Kolos, W. (Univ. of Chicago). J. Math. Phys. (N. Y.), 8: 1093-4(May 1967).

A simple recursion scheme is set up for the higher derivatives of functions of the form $f(\alpha,\beta)(\alpha+\beta)^{-1}$ and $f(\alpha,\beta,\gamma)(\alpha+\beta+\gamma)^{-1}$ and applied to the rapid calculation of the Calais–Löwdin two-particle atomic integrals. (auth)

39821 ATOMIC MOTION IN LIQUID ARGON. Skold, K. (Aktiebolaget Atomenergi, Studsvik, Sweden); Larsson, K. E. Phys. Rev., 161: 102-16(Sept. 5, 1967).

The atomic motion in liquid argon at 94°K has been investigated by inelastic scattering of 4.1 Å neutrons. Special attention was paid to the collective aspects of the motion, and the observations were therefore confined to momentum transfers κ in the region $1.3 < \kappa < 3.3$ Å^{-1}, which includes the main peak of the liquid structure factor. The results are compared with various models. These comparisons give strong evidence of collective modes, and an extreme polycrystalline model, in which even the polarization of the phonons is retained, gives the best description of the data. There is also definite evidence of a second Brillouin zone in liquid argon. A dispersion relation is obtained with a slope close to the measured velocity of sound and in good agreement with earlier neutron results. The frequency spectrum has been determined and is compared with the results of a computer calculation by Rahman. (auth)

39822 COLLISION SPECTROSCOPY. I. ANALYSIS OF THE SCATTERING OF He^+ BY Ne AND Ar. Smith, F. T. (Stanford Research Inst., Menlo Park, Calif.); Marchi, R. P.; Aberth, W.; Lorents, D. C.; Heinz, O. Phys. Rev., 161: 31-46(Sept. 5, 1967).

Experimental data on the differential scattering of He^+ by Ne and Ar in the energy range from 10 eV to 100 keV are plotted in a reduced coordinate system suggested by a scaling law for the forward scattering. The resulting curves are used to determine the interaction potential. The repulsive interaction dominating at higher energies shows shows pronounced shell-structure effects, leading to the deduction of the screening constants for the L and M shells of Ar and for the K and L shells of Ne. At lower energies a polarization attraction appears, allowing deduction of the polarizabilities of Ne and Ar. A simple analytic potential is constructed, including a polarizability term appropriately damped inside the outer shell, which fits the data over the entire range. In addition to the pure elastic scattering, effects of inelastic interactions are diagnosed. A prominent curve crossing is located and the scattering pattern arising from it is interpreted by a semiclassical theory. In collisions with closer encounters, a different type of inelastic process appears, which apparently involves a more intense coupling than the curve crossing and which appears to open up a number of competing inelastic channels. (auth)

39823 MEAN LIFETIMES OF THE 2p AND 3p LEVELS IN He II. Heroux, L. (Air Force Cambridge Research Labs., Bedford, Mass.). Phys. Rev., 161: 47-50(Sept. 5, 1967).

The foil-excitation technique has been used to measure the mean lifetimes of the 2p and 3p levels in He^+. The measured lifetimes agree with the theoretical values, the measured accuracy being ±3% for the 2p level and ±10% for the 3p level. The mean lives were determined from the decay of the two emission lines 1s–2p at 304 Å and 1s–3p at 256 Å as a function of distance from the intersection of the foil and beam. Cascading into the 2p and 3p levels was observed, and corrections for cascading were necessary to determine the lifetimes. The observed cascading was found to be in reasonable agreement with the theoretically predicted cascading from adjacent excited levels of He^+. (auth)

39824 ATOMIC PHOTOIONIZATION CROSS SECTIONS FROM A SEMIEMPIRICAL CENTRAL POTENTIAL. McGuire, Eugene J. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 161: 51-9 (Sept. 5, 1967).

The exact solutions for the Schrödinger equation with a central potential of the form $V(r) = 2Z/r - \Delta$, $r \le r_1$; $V(r) = 2/r$, $r \ge r_1$; $r_1 = 2(Z-1)/\Delta$ are developed. Z and Δ are chosen to fit observed term values for various atoms, and the parametrized continuum orbitals are used to calculate the photoionization cross section of these atoms. For certain transitions the photoionization cross-section matrix element can be written as an exact expression. This is done for valence photoionization in He and the alkalis, for 4d-shell photoionization in the elements indium to xenon, and for the 3d shell in krypton. The relationship between this approach and the Coulomb method of Burgess and Seaton is briefly discussed. (auth)

39825 HYPERFINE STRUCTURE AND g_J VALUE OF THE $^2D_{\frac{5}{2}}$ AND OF THE $^4F_{\frac{9}{2}}$ STATES OF ^{197}Au. Blachman, Arthur G.; Landman, Donald A.; Lurio, Allen (Columbia Univ., New York). Phys. Rev., 161: 60-7(Sept. 5, 1967).

The hyperfine structure (hfs) and g_J value of the metastable $(5d^96s^2)$ $^2D_{\frac{5}{2}}$ and of the $(5d^96s6p)$ $^4F_{\frac{9}{2}}$ levels in ^{197}Au have been measured by the atomic-beam magnetic-resonance method. The results for the hfs interaction constants, which have been corrected for second-order interactions with neighboring fine-structure levels, are $A(^2D_{\frac{5}{2}}) = 199.8425(2)$ Mc, $B(^2D_{\frac{5}{2}}) = -911.0766(5)$ Mc, $C(^2D_{\frac{5}{2}}) = 0.000212(14)$ Mc, $A(^4F_{\frac{9}{2}}) = 432.276(1)$ Mc, $B(^4F_{\frac{9}{2}}) = -540.026(17)$ Mc, and $C(^4F_{\frac{9}{2}}) = 0.00326(10)$ Mc. A detailed interpretation of these measurements together with those of Goodman and Childs on the $(5d^96s^2)$ $^2D_{\frac{5}{2}}$ level yields a value for the quadrupole moment of $Q = 0.594(10)$ b without the Sternheimer correction. A consistent value for the octupole moment could not be obtained. From the Zeeman effect of the hfs it was found that $g_J(^2D_{\frac{5}{2}}) = 0.799(1)$ and $g_J(^4F_{\frac{9}{2}}) = 1.334(2)$. (auth)

39826 ELASTIC SCATTERING OF LOW-ENERGY ELECTRONS BY METASTABLE He IN THE POLARIZED-CORE DISTORTED-WAVE APPROXIMATION. Husain, D. (Dacca Univ., Pakistan); Choudhury, A. L.; Rafiqullah, A. K.; Nestor, C. W. Jr.; Malik, F. B. Contract W-7405-eng-26. Phys. Rev., 161: 68-73 (Sept. 5, 1967). (ORNL-P-3284).

Cross sections for elastic scattering of slow electrons (<10 eV) by He(1s, 2s) ^{1,3}S have been computed in the static Hartree–Fock field and in the induced-polarization potential field of the atom, using the approximate parametrized form of Reeh's potential. The equation describing the complete elastic scattering process has been deduced from the Schrödinger equation. The potential terms are identified as the static central and the induced polarization potential. The scattering equation is numerically integrated to obtain the phase shifts for each partial wave. The computed cross section can satisfactorily account for the observed cross section. The characteristic feature is the relatively large contribution of higher partial waves to the total cross section, and the contributions of nine partial waves have been included. (auth)

39827 COLLISIONS OF ALUMINUM AND IRON IONS AND ATOMS WITH GASES IN THE ENERGY RANGE 5 keV TO 2.5 MeV. Layton, J. K. (General Atomic Div., General Dynamics Corp., San Diego, Calif.); Stebbings, R. F.; Brackmann, R. T.; Fite, W. L.; Ott, W. R.; Carlston, C. E.; Comeaux, A. R.; Magnuson, G. D.; Mahadevan, P. Phys. Rev., 161: 73-84(Sept. 5, 1967).

Electron capture, electron loss, and ionization have been studied for aluminum and iron ions and atoms passing through N_2, O_2, and Ar. The experiments, which took place in three separate laboratories, had available the energy range from 5 keV to 2.5 MeV. In addition to presenting the cross sections and the methods employed, the paper contrasts the effects of projectile particles having low first and second ionization potentials with those of the more usually studied projectiles having ionization potentials comparable with those of the target gas. Of particular interest is the comparison of charge-transfer versus ion-stripping probabilities. The results are compared with some of the present approximate theories. (auth)

39828 BREMSSTRAHLUNG CROSS-SECTION MEASUREMENTS AT INCIDENT ELECTRON ENERGIES OF 1.0, 1.7, AND 2.5 MeV. Rester, D. H.; Dance, W. E. (Ling-Temco-Vought, Inc., Dallas). Phys. Rev., 161: 85-93(Sept. 5, 1967).

Measurements of electron-bremsstrahlung cross sections have been made for incident electron energies of 1.0, 1.7, and 2.5 MeV and targets of Al, Cu, Sn, and Au. Data are included at angles of observation from 0° to a limiting angle including more than 90% of the total emitted bremsstrahlung at each incident electron energy. The present measurements are lower than the results of Motz for Al and Au at 1.0 MeV; however, the present results at 2.5 MeV agree with the results of Starfelt and Koch at 2.72 MeV. Comparison with the Born approximation indicates that the experimental cross sections are larger than predicted near the high-frequency limit. This effect increases with atomic number at a given energy but decreases with energy, as expected. (auth)

39829 RELAXATION-TIME APPROXIMATION FOR THE MOBILITY OF ELECTRONS IN HELIUM. Coopersmith, Mi-

chael H. (Case Inst. of Tech., Cleveland. Western Reserve Univ., Cleveland); Neustadter, Harold E. Phys. Rev., 161: 168-72(Sept. 5, 1967).

Kubo's theory of irreversible quantum statistics is applied to the problem of electron mobility in a hard-core gas. Without any assumptions regarding a relaxation time, the mobility is evaluated by cumulant techniques to first order in the gas density and second order in the scattering length. A momentum-dependent relaxation time appears in a natural manner, as does the criterion for validity of the classical Langevin theory. (auth)

39830 MEASUREMENT OF ABSOLUTE YIELD OF FLUORESCENT X-RAYS EMITTED FROM A TARGET IRRADIATED WITH GAMMA-RAYS. Ghumman, B. S.; Anand, S.; Sood, B. S. (Punjabi Univ., Patiala, India). Curr. Sci. (India), 36: 344 (July 5, 1967).

The value of the absolute yield of fluorescent K radiation was calculated from the intensity measured under the photopeak in the spectrum of the radiation obtained by a NaI(Tl) spectrometer. Measurements are presented for ^{203}Hg, ^{198}Au, ^{141}Ce, and ^{137}Cs. (M.O.W.)

39831 BOUNCING SPHERES IN GENERAL RELATIVITY. Bondi, H. (London Univ.). Nature (London), 215: 838-9(Aug. 19, 1967).

An analysis is presented of the radial adiabatic motion of spherically symmetric models of uniform density and isotropic pressure in general relativity. By "bounce" is signified reversal of motion. A sample set of results is given. (UK)

39832 EXPERIMENTAL RESEARCH ON THE SECONDARY ELECTRON EMISSION OF A METALLIC SURFACE WITH IMPACT OF A MOLECULAR BEAM OF HIGH ENERGY. Devienne, F. Marcel (Laboratoire Mediterraneen de Recherches Thermodynamiques, Nice). J. Phys. (Paris), 28: 602-10(July 1967). (In French).

An attempt was made to determine the influence of numerous factors on the variation of γ, i.e., the secondary electronic emission yield produced by the impact of high-energy molecules on a metallic surface. After setting up a method for measuring γ, the influence of outgassing the surface, of the energy of the incident molecules, as well as the influence of the nature of the surface and its temperature are shown. The influence of contamination of the solid surface, the influence of the angle of incidence and, in addition, the influence of the nature of the incident molecules and their atomicity were also studied. As a result of the excellent reproductivity of the measurements carried out on tungsten under the impact of molecular beams of different nature, it is suggested that the measurement of the secondary electronic current emitted by the tungsten brought to a temperature ranging between 600° and 800°C be applied, in order to determine the intensities of very low molecular beams. The intensities of molecular beams ranging between 10^3 to 10^4 mol/cm^2 · s at an energy ranging about 3000 eV can be measured. (auth)

39833 ELECTRON BEAMS IN SCIENCE AND TECHNOLOGY. Bakish, R. 26p. (CONF-650939-2). DTIE.

From 2nd International Symposium on Hyperpure Products in Science and Technology, Dresden.

The present status of the electron beam as a materials processing tool both for scientific investigations and industrial applications is reviewed. The discussion considers the many areas of applications but places special emphasis on melting, refining, welding, and heat treating. The presentation is concluded with a look into the future of electron beam technology. (auth)

39834 ENERGY DEPENDENCE OF REACTIONS OF O^+ WITH N_2, O_2. PART I. Bohme, D. K. (Univ. of London); Ong, P. P.; Hasted, J. B.; Megill, L. R. 8p. (CONF-670429-5). DTIE.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

Rate constants for $O^+ + O_2 \rightarrow O_2^+ + O$, (1) and $O^+ + N_2 \rightarrow NO^+ + N$, (2) were measured with the drift-tube technique, using ground state O^+ ions. The energy variation for (1) is slight from 0.07 eV (2×10^{-11} cm^3 sec^{-1}) to 0.2 eV (3×10^{-11} cm^3 sec^{-1}) but it rises almost linear with energy to 9×10^{-10} cm^3 sec^{-1} at 20 eV. The rate for (2) rises almost linear with energy from 7×10^{-12} cm^3 sec^{-1} at 0.07 eV to 3×10^{-10} cm^3 sec^{-1} at 10 eV. (auth)

Cosmic Radiation

Refer also to abstracts 39774, 39888, and 39889.

39835 (NYO-3038-5) COSMIC RAY DETECTION BY ATMOSPHERIC FLUORESCENCE. Bunner, Alan Newton (Cornell Univ., Ithaca, N. Y. Lab. of Nuclear Studies). Feb. 1967. Contract AT(30-1)-3038. 204p. Dep. CFSTI.

Thesis.

The purpose of this thesis is to discuss the technique of using the atmosphere as a scintillator for the study of very high-energy cosmic particles. (W.D.M.)

39836 FORBUSH EFFECT IN NUCLEAR COMPONENT OF THE COSMIC RAYS DURING SUDDEN MAGNETIC STORMS. Kurnosova, L. V.; Razorenov, L. A.; Suslov, A. A.; Fradkin, M. I. Kosm. Issled. Akad. Nauk SSSR, 5: 259-64(Mar.-Apr. 1967). (In Russian).

By the method of superposition of periods, the connection of the intensity of the different groups of nuclei with the K index of the geomagnetic activity was investigated. Two cases of Forbush effect, recorded in February 1964 and in February 1965 at the time of the flight of the Electron-2 and Electron-4 Sputniks, were described. At the limit of error of the measurement the degree of modulation indicated similarity for the different groups of nuclei. (tr-auth)

39837 CONSEQUENCES OF THE DISTRIBUTION OF GALACTIC COSMIC-RAY DENSITY IN THE SOLAR SYSTEM. Subramanian, G.; Sarabhai, Vikram (Physical Research Lab., Ahmedabad, India). Astrophys. J., 149: 417-28(Aug. 1967).

The anisotropy of galactic cosmic rays in interplanetary space arising from three assumed distributions of cosmic-ray density, dependent on heliolatitude according to a model recently suggested (A.J., 145: 206, 1966), is estimated. While all distributions have larger cosmic-ray densities at high heliolatitudes than in the equatorial plane, the first has symmetry with respect to the equatorial plane, the second has a north–south asymmetry, and the third is symmetrical with respect to the equatorial plane but has two minima of cosmic-ray density at heliolatitudes ±10° corresponding to the zones of maximum solar activity. The cosmic-ray gradient in the vicinity of Earth has been assumed to be 6 percent/a.u. for particles of rigidity $P > 2$ GV, perpendicular to the plane of the ecliptic. A mechanism is discussed which can explain the direction and magnitude of the semidiurnal component of cosmic-ray intensity. Change of 24-hour mean cosmic-ray intensity and a diurnal anisotropy are also produced and, like the semi-diurnal component, are related to the cosmic-ray density gradients normal to the ecliptic and the magnitude of the interplanetary magnetic field. The diurnal anisotropy discussed in this model should reverse its direction of maximum with the reversal of the direction of the interplanetary magnetic field as well as with the reversal of the direction of the cosmic-ray gradient. Averaged over a solar rotation the diurnal component will therefore be negligible in comparison with the diurnal anisotropy arising from azimuthal streaming. Daily variation and 24-hour mean intensity were calculated for neutron monitors at Huancayo and Deep River using the model and with assumed form and magnitude of the latitudinal gradient. The derived cosmic-ray effects are consistent with experimental observations. Of particular interest is the ability of the model to explain the direction, magnitude, and the energy dependence of the semidiurnal component. Along with the mechanism of outward convection of cosmic rays by the solar wind and the anisotropic diffusion inward, the model therefore appears to be a good candidate for developing an integrated interpretation of cosmic-ray variations. The model moreover provides the interesting possibility of sampling the conditions of interplanetary magnetic field and cosmic-ray density in regions of the solar system at 1 a.u. but extending to ±30° outside the equatorial plane, using quantitative data of cosmic-ray anisotropy and day-to-day changes of omnidirectional intensity. (auth)

39838 COSMIC-RAY PROPAGATION. II. DIFFUSION IN THE INTERPLANETARY MAGNETIC FIELD. Jokipii, J. R. (Univ. of Chicago). Astrophys. J., 149: 405-15(Aug. 1967).

The motion of cosmic rays in interplanetary space as determined by observed magnetic-field power spectra is discussed in detail, extending the analysis in an earlier paper. The assumptions of statistical homogeneity and isotropy of the magnetic fluctuations are critically examined, and the conditions under which diffusion adequately describes the particle motion are defined. It is concluded that the small cyclotron radius limit is applicable to particles less than a few GeV energy. From the reported power spectra, it is concluded that the motions of cosmic rays with kinetic energies between about 10 MeV/nucleon and a few GeV/nucleon are well represented by diffusion with a diffusion tensor proportional to $R\beta$, where R is the particle magnetic rigidity and $c\beta$ is its velocity. The parallel diffusion coefficient $\kappa_{||}$ has a value $\sim 2 \times 10^{21}$ cm^{2}sec^{-1} for 100 MeV protons, whereas the perpendicular component is much smaller. Parker's model for the long-term modulation of galactic cosmic

rays, including adiabatic deceleration, is generalized to include an energy dependent diffusion coefficient. The predictions of this model, with $\kappa \propto R\beta$, are consistent with the observed long-term variations and radical gradient of galactic cosmic rays during the period approaching solar minimum. This is in agreement with earlier conclusions based on the simple diffusion-convection model, neglecting adiabatic deceleration. However, a definitive test of this general picture awaits more detailed and simultaneous measurements of cosmic rays and the interplanetary magnetic-field irregularities. In particular it is found that the quantitative predictions of the model may depend in a significant manner on the heliocentric radial variation of κ. (auth)

39839 DIMENSION OF THE COSMIC RAY MODULATION REGION. Simpson, J. A.; Wang, J. R. (Univ. of Chicago). Astrophys. J., 149: L73-8(Aug. 1967).

There is an order of magnitude difference between the effective depth L of the 11-year solar modulation region derived from recent space probe measurements (L < 5 A.U.) and derived from the dynamical phase lag of changes in cosmic-ray intensity and solar activity (L > 40 A.U.) near the solar minimum of 1965. By assuming that changes in solar coronal emission (at 5303 Å), instead of changes in sunspot number or radio emission, are correlated with solar-wind characteristics responsible for modulation, there is a reduced dynamical phase lag which leads to L ≤ 10 A.U. (auth)

39840 INTERACTION OF COSMIC RAYS WITH THE SOLAR AND TERRESTRIAL MAGNETIC FIELDS. Quenby, J. J. (Imperial Coll. of Science and Tech., London). pp 415-26 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Current ideas about the interaction of cosmic rays with the various fields within the solar system are outlined under the topics geomagnetic effects due to the internal currents, geomagnetic effects due to external currents system, modulation of the galactic intensity by the interplanetary field, solar energetic particle events, and particle acceleration in solar flares. (W.D.M.)

39841 UPPER LIMIT ON THE ABUNDANCE OF ANTIPROTONS IN THE LOW-ENERGY GALACTIC COSMIC RADIATION. Apparao, M. V. K. (Tata Inst. of Fundamental Research, Bombay). Nature (London), 215: 727-8(Aug. 12, 1967).

It has been argued that cosmic rays reaching the Earth may not contain antinuclei. Even so, the cosmic rays should contain secondary antiprotons produced in collisions of cosmic-ray protons with interstellar hydrogen. Estimates of the abundance of secondary antiprotons have been made by several authors, and it has been stated that the ratio $\bar{p}/p$ at low energies may be several orders of magnitude greater than that calculated at high energies. Attempts have also been made to detect antinuclei with charge $Z \geq 6$ in cosmic radiation. No such nucleus has so far been detected, and upper limits have been set to the ratio of these antinuclei to normal nuclei, the lowest being 10^{-3}. If antinuclei exist in cosmic rays at balloon altitudes it is likely that they exist as antiprotons. In the experiments described a nuclear emulsion stack was exposed at Fort Churchill, Canada, on August 4th 1962 for 13 h, 52 min under 4.2 g/cm^2 residual atmosphere. The experimental procedure consisted in looking for the "signature" of an antiproton, which is an interaction or "star" produced by an incoming slow particle with at least one minimum ionizing singly charged particle track (π meson) associated with it. A total volume of 4.5 cc from three emulsion plates has so far been examined, and from about 5,000 stars only one antiproton star was found, and the antiproton producing this interaction came from another interaction within the emulsion stack itself. An upper limit for $\bar{p}/p$ was set as $\lesssim 3 \times 10^{-4}$. (UK)

39842 COSMIC-RAY DISTRIBUTION AND THE ACCEPTANCE VECTORS OF DETECTORS. I. Krymskii, G. F.; Kuz'min, A. I.; Chirkov, N. P.; Krivoshapkin, P. A.; Skripin, G. V.; Altukhov, A. M. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 774-8(1966).

Translated from Geomagn. Aeronomiya, 6: 991-6(1966).

Cosmic-ray distribution over a sphere is examined. The distribution is represented by a series of spherical functions orthogonal on the sphere. The concept of an acceptance vector of a detector is introduced, which makes it possible to allow for the influence of the atmosphere, of instrument characteristics, and of the geomagnetic field on cosmic-ray intensity variations. (auth)

39843 BAROMETRIC EFFECT OF COSMIC RAYS WITH ALLOWANCE FOR THE VARIATIONS OF THE PRIMARY SPECTRUM AND OF THE CUTOFF RIGIDITY. Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 854-6(1966).

Translated from Geomagn. Aeronomiya, 6: 1096-7(1966).

An attempt is made to generalize the concept of the barometric effect of cosmic rays and to account not only for the possible influence on it of variations in the primary spectrum, but also of possible variations in cutoff rigidity caused by the instability of the geomagnetosphere. (J.H.M.)

39844 QUASI-SPIRAL CHARACTER OF THE CHANGE OF THE 27-DAY COSMIC-RAY VARIATION WITH SOLAR ACTIVITY. Alaniya, M. V.; Dorman, L. I.; Shatashvili, L. Kh. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow. Inst. of Geophysics, Tbilisi, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 856-8(1966).

Translated from Geomagn. Aeronomiya, 6: 1098-1100(1966).

To study the amplitude and phase variations of the 27-day wave of cosmic-ray intensity, a harmonic analysis was performed on 27 ordinates of the average diurnal intensity values of the neutron component at Climax and Norikura. The results are given and readily understood on the basis of an idea previously advanced regarding the production of the 27-day cosmic-ray variation by an asymmetric stream of magnetic inhomogeneities from the Sun. (J.H.M.)

39845 SEASONAL CHANGES OF THE SOLAR-DIURNAL AND SEMIDIURNAL COSMIC-RAY VARIATIONS. Dorman, L. I.; Kolomeets, E. V.; Sergeeva, G. A. (Kazakh State Univ., Alma-Ata, USSR. Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 858-60(1966).

Translated from Geomagn. Aeronomiya, 6: 1101-3(1966).

The solar–diurnal and semidiurnal variations of the intensity of the neutron component of cosmic rays are analyzed from the data of a global network of stations for the period 1958 to 1962. Mean monthly 2-hourly intensity valves were used to find the variations. All stations were broken down into three belts with average cutoff energies 1.4, 4.2, and 12.0 BeV. Then the average amplitudes of the solar–diurnal variation were found for each year by belts. Amplitude deviations from average values indicate a change in the solar–diurnal variation through the year. (J.H.M.)

39846 FLUX OF SLOW NEUTRONS IN THE ATMOSPHERE. Sokolov, V. D. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 864-6(1966).

Translated from Geomagn. Aeronomiya, 6: 1107-9(1966).

Results are reported of measurements of the flux of slow neutrons with energies from thermal to 100 eV, made on sounding balloons from 1960 to 1962. Neutron intensity was measured by type SNM-5 counters, filled with BF_3. (J.H.M.)

Direct Energy Conversion

Refer also to abstracts 39658 and 39687.

39847 (JPRS-42212) APPROXIMATE DIFFUSION THEORY OF THERMIONIC CONVERTERS. Nastoyashchiy, A. F. Translated from At. Energ. (USSR), 23: 42-3(1967). 3p. (TT-67-32842). CFSTI.

Equations are given for expressing diffusion in thermionic converters. The expressions indicate that, if the mobility of the electron does not depend on its energy, the volt–ampere characteristics of thermionic converters can be described by simple formula. (J.H.M.)

39848 THERMOELECTRIC POWER IN THE NEARLY-FREE-ELECTRON MODEL. Robinson, John E. (Argonne National Lab., Ill.). Phys. Rev., 161: 533-9(Sept. 15, 1967).

The thermoelectric power in the nearly free-electron model is re-examined with specific reference to the especially long-standing theoretical problem posed by occurrences among pure monovalent metals of a negative Hall coefficient but a positive electron-diffusion thermopower. The physical picture is clarified by referring steady-state excitations of the electron gas to the current-free equilibrium distribution, and a summary is given of the evidence that shows Fermi-surface anisotropy to be unimportant for an explanation of the "reversed sign" thermopowers. It is pointed out that the scattering of an electron by the pseudopotential of a single ion generally exhibits Coulomb-core interference, which is the analog of the Coulomb-nuclear interference in nuclear physics, and that this can yield the required energy dependence of the transport mean free path. This is illustrated by a model calculation, which allows analytic evaluation of all results and which contains only the simplest ingredients: free electrons, a relaxation time, an isotropic elastic-continuum structure factor

for acoustic phonons, and a point-ion pseudopotential. The model can accommodate a rather wide range of thermopower coefficients of either sign, and allows a sharp reversal of sign for modest changes of the parameters. Although no quantitative comparison is attempted, estimates of the parameter values appropriate to real systems indicate that Coulomb-core interference effects discriminate between real metals rather satisfactorily and are, in fact, strong enough to produce positive thermopowers with little, if any, additional help. (auth)

39849 STATUS OF MAGNETOHYDRODYNAMIC POWER GENERATION FOR TERRESTRIAL APPLICATIONS. Yeh, Hsuan (Univ. of Pennsylvania, Philadelphia). New York, American Institute of Aeronautics and Astronautics, 1966, Preprint No. 66-1013, 5p., $1.50. (CONF-661124-5). DTIE.

From 3rd AIAA Annual Meeting, Boston.

There are two schemes by which MHD power can be generated: an open cycle using fossil fuel as the heat source and a closed cycle using a nuclear reactor as the heat source. The first scheme requires its working medium (seeded combustion gas) attain a temperature of 2600° to 2800°K. Consideration is given to problems that are related to magnet and preheater design, recycling of seeding material, and materials for electrodes and insulators at high temperatures. With the intense research going on at present in these problems, there is little doubt that MHD open cycle power generation on a large scale and for a prolonged period of time can be accomplished; whether it is competitive economically with conventional devices is difficult to predict, since it will be dependent on a number of imponderable factors. The closed cycle MHD device may use either seeded noble gas or liquid metal as the working medium. Due to low thermal efficiency (10 to 15% at best) the liquid metal type can be practically ruled out for large scale commercial applications. The closed cycle MHD device using noble gas as the working fluid is dependent on the development of a high-temperature gas-cooled reactor at 1700°K or above. Such a reactor is not yet available. (auth)

39850 IMPROVEMENTS IN OR RELATING TO MAGNETOHYDRODYNAMIC GENERATORS. Robbins, Eric John (to United Kingdom Atomic Energy Authority). British Patent 1,082,345. Sept. 6, 1967. Filed May 1, 1963.

A magnetohydrodynamic generator is designed with a nozzle in the duct through which vaporized metal is expanded substantially adiabatically to provide a working fluid of partially condensed vapor. Convenient metals for the purpose are the alkali metals or Ca or Ba or combinations of these. The metal vapor may be carried in a gas. Means are provided for condensing the vapor after it has passed through the duct and returning it to the vaporizing means. (A.G.W.)

39851 IMPROVED MAGNETOHYDRODYNAMIC GENERATOR. (to Compagnie Generale D'Electricite). British Patent 1,082,147. Sept. 6, 1967. Priority date Oct. 24, 1963, France.

In a magnetohydrodynamic generator of the segmented-electrode type, the boundary layer of the working fluid is ionized by applying a voltage to promote arcing in the direction of working-fluid between current-collecting electrodes on the same side of the channel. The electrodes between which a discharge is to be created may be connected to the secondary windings of transformers, the primary windings of which are connected to an ancillary ac supply source. Alternatively, when the voltages originating through the Hall effect between the electrodes located on the same face of the channel are sufficiently high, the electrodes are connected by resistances and no special ancillary current supply is required. (A.G.W.)

39852 INTERNATIONAL CONFERENCE ON THERMIONIC ELECTRICAL POWER GENERATION, LONDON, SEPT. 20–25, 1965. London, Institution of Electrical Engineers, 1967. 427p. (CONF-650908).

Seventy-nine papers on various aspects of thermionic electric power generation are presented. Principal topic areas are: theoretical considerations, heat pipe systems, converter performance, in-pile studies, plasma properties, surface phenomena, construction materials, and applications. (J.H.M.)

Fluid Physics

Refer also to abstracts 40012 and 40530.

39853 (SC-DC-67-1974) TRANSPORT CHARACTERISTICS OF PARTIALLY IONIZED GASES. Kelleher, Dermod; Everett, Willis L. (New Mexico Univ., Albuquerque. Dept. of Nuclear Engineering). Aug. 1967. Contract AT(29-1)-789. 4p. (CONF-670810-2). Dep. CFSTI.

From 8th International Conference on Phenomena in Ionized Gases, Vienna, Austria.

Generalized transport equations, obtained from velocity moments of the Boltzmann equation, are closed out utilizing Grad 13-moment approximations for the distribution functions. Relations characterizing transport phenomena in partially and fully ionized gases in the presence of electric and magnetic fields of arbitrary magnitude are investigated in detail. (W.D.M.)

39854 ELECTROMAGNETOHYDRODYNAMIC ENERGY CONVERSION. Sexl, Theodor; Engelbert, Hubert (Univ., Vienna). Acta Phys. Austr., 25: 173-81(1967). (In German).

The energy conversion in the electromagnetohydrodynamics of an electrically conducting liquid was derived in an expansion of two previous studies. The total energy in a stationary volume is modified so that through the closed envelope of the selected volume energy flows and in the volume itself hydrodynamics and electromagnetic energy is converted into heat. (tr-auth)

39855 MAGNETOHYDRODYNAMIC ENERGY CONVERSION. Blazso, Tibor (Zentrallaboratorium fuer Messtechnische Forschung, Budapest). Acta Phys. Austr., 25: 130-5(1967). (In German).

A generalized consideration of the energy species occurring in plasma is presented. The energy equation for ideal liquids and the energy equation of an ideal magnetohydrodynamic medium are derived. The energy equation of a magnetohydrodynamic medium with finite electrical and thermal conductivity and internal friction is given. (J.S.R.)

39856 MAGNETOHYDRODYNAMIC FLOW AT A REAR STAGNATION POINT. Leibovich, S. (Cornell Univ., Ithaca, N. Y.). J. Fluid Mech., 29: 401-13(Aug. 1967).

An exact rear stagnation point solution is sought for a viscous, incompressible conducting fluid in the presence of a magnetic field. It is found that a steady solution exists only if $N \geq 2$, where $N = \sigma B^2/\rho\alpha$ is the interaction parameter of the flow based upon the normal component of the magnetic field at the wall. Here α is a positive rate of strain, which, for a finite body with length l and velocity U_0, is of the order of U_0/l. The steady solution is found, and from its existence it is inferred that separation of the viscous boundary layer does not begin at the rear stagnation point when $N \geq 2$, and that such separation can be prevented. This supports theoretical work by Moreau (1964) and experimental work of Tsinober, Shtern and Shcherbinin (1963). When $N < 2$, the flow is necessarily unsteady, and in this case an asymptotic analysis (as $t \to \infty$) similar to that of Proudman and Johnson (1962) is undertaken. For $N < 1$, the magnetic and nonmagnetic flows are qualitatively alike, in that there is a growing inviscid region dominated by eddies and an ultimately steady layer at the wall representing a viscous forward stagnation point flow. For $1 < N < 2$, the inviscid region again grows with time, but no eddies appear. It is thus suggested that for this range of N separation occurs without reversed flow. (auth) (UK)

39857 CALCULATION OF MAGNETOGASDYNAMIC FLOW. Litvak, A. K.; Pankratov, V. G. Zh. Vychisl. Mat. i Mat. Fiz., 7: 698-704(May-June 1967). (In Russian).

Magnetohydrodynamic flow (MHD) involves the motion of an electrically conducting liquid or gas between two metallic plates or tubes, to which a difference in potential is applied. The interaction of the resulting current with the magnetic field leads to the appearance of electrodynamic volume forces acting on the current. In order to calculate the hydrodynamic and magnetodynamic quantities required for determining the MHD flow, a general set of equations involving mass transfer, thermodynamic, and electrodynamic variables are formulated. This general set is converted to a scalar set of equations for stationary flow by assuming that the flow of particles is quasi-neutral, that end effects can be neglected, that the electron pressure gradient is small, that the radial and azimuthal velocity components are small, and that the transfer coefficients are constant over a small region. The relation between velocity and temperature is assumed to be different for laminar flow near the wall compared to turbulent flow in the main body of the fluid. The full set of equations is subdivided into two subsets, a gasdynamic set and a magnetodynamic set. The set of matrix-vector equations can be solved by specifying the boundary conditions such as the velocity, pressure, and temperature at the entrance, and the current and difference in potential. An example is given as an illustration of the calculation. (TTT)

39858 MAGNETOHYDRODYNAMICS OF LIQUIDS. Ferraro, V. C. A. (Univ. of London). pp 85-94 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Those parts of magnetohydrodynamics which are of interest in connection with theories of cosmic and stellar magnetic fields are briefly reviewed in terms of mechanical equations, Alfvén's theorem and Alfvén waves, the magnetic Reynolds number, isorotation, dynamo action, flow through ducts, and magnetohydrostatics and force-free fields. (W.D.M.)

39859 COMMENTS ON THE THEORY OF HOMOGENEOUS DYNAMOS. Gibson, R. D.; Roberts, P. H. (Univ. of Newcastle upon Tyne, Eng.). pp 108-20 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

The dynamo problem is the search for answers to the questions, "Can a steady magnetic field be entirely maintained by a (fixed) volume of conducting fluid through motions taking place in its interior?" and, "If so, how?" Some of the theoretical progress which has been made in answering these questions is briefly reviewed, and a few minor points of interest noted in the course of a study of them are reported. (W.D.M.)

39860 BOUNDARY-VALUE PROBLEMS IN COMPRESSIBLE MAGNETOHYDRODYNAMICS. Salathe, Eric P.; Sirovich, Lawrence (Brown Univ., Providence). Phys. Fluids, 10: 1477-91 (July 1967).

Linearized steady two-dimensional compressible magnetohydrodynamics is considered. No restriction on the gas law or on the field orientations is made. Thin-body flow problems are solved for all slow field regimes (e.g., doubly hyperbolic, hyperliptic). The method of solution is based on replacing material boundaries by surfaces of discontinuity. The discontinuous forms of the magnetohydrodynamic equations are derived in full generality. It is then shown that the solution to any problem may be represented in terms of the fundamental solution. The latter is obtained in closed form for all regimes. The final solution is then reduced to a single integral equation which may be solved in all cases. (auth)

39861 COMBINED FREE AND FORCED CONVECTION IN MHD. Farn, C. L. S.; Hughes, W. F. (Carnegie Inst. of Tech., Pittsburgh). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/HT-38, 6p., $1.50. (CONF-661102-16). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

A study is made of the combined free and forced convection over a semi-infinite electrically insulating vertical plate of constant temperature with a transverse magnetic field for two cases: the plate moving with constant velocity either in the direction of gravity or opposite to it. A perturbation solution (to second order) in Grashof number is assumed for velocity and temperature. The functions of each order are then expanded in terms of the Hartmann number. By the introduction of a similarity variable, a set of ordinary differential equations are obtained and solved by numerical means. Results for the drag coefficient and Nusselt number are plotted for two values of Prandtl number, 0.72 and 0.025. It was found that the Nusselt number has an extremum as the Grashof number is varied even for zero Hartmann number. The value of the Grashof number at which the extremum occurs depends on the Hartmann number. (auth)

39862 AN EXPERIMENTAL STUDY OF MHD FLOW BETWEEN CONCENTRIC TUBES. Caddell, Robert N.; Hansen, Arthur G. (Univ. of Michigan, Ann Arbor). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/FE-35, 8p., $1.50. (CONF-661102-12). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

The motion induced by applied electric and magnetic fields on an initially static fluid contained between two concentric tubes was observed and photographed. A fine grit aluminum pigment, which was in suspension in a solution of copper sulphate, provided a means for photographing internal streamlines and obtaining velocity measurements. These experimental findings were compared with theoretical predictions from an analytical solution by two other authors as certain similarities existed between the models employed. It should be realized that this experimental study was not conducted to corroborate this analytical work. These independent studies are compared only because they are both concerned with a similar problem. (auth)

Geophysics

Refer also to abstracts 39294, 39778, 39834, 39836, 39840, 39843, and 39859.

39863 (AD-650623) THE TROUGH SEEN IN HIGH-LATITUDE OBSERVATIONS OF THE IONOSPHERIC ELECTRON CONTENT. Liszka, Ludwik (Kungliga Vetenskapsakademien, Kiruna (Sweden). Geofysiska Observatoriet). Jan. 9, 1967. Contract AF 61(052)-678. 37p. (AFCRL-67-0175). CFSTI.

Results of 15 months observations of the ionospheric electron content made at Kiruna, Sweden, are presented. Observations were made using the 40 and 41 MHz beacon of the S-66 satellite. Most of the night-time observations, except for the summer period, show a distinct trough in the electron content. Seasonal and diurnal variations of the trough and of the electron content are studied. Also the corresponding equivalent slab thickness obtained using f_0F2 data from 6 Scandinavian ionosondes and geomagnetic control of the trough are investigated. Some features of the diurnal variation of electron content during the summer agree with the hypothesis of ionospheric heating by photoelectrons from the sunlit magnetic conjugate ionosphere. (auth) (TAB)

39864 (AD-650873) DETERMINATION OF A D-REGION NITRIC OXIDE DENSITY PROFILE BY VLF RADIO PROPAGATION. Hayes, Daniel P.; Sales, Gary S. (Lowell Technological Inst., Mass. Research Foundation). Feb. 1967. Contract AF 19(628)-4801. 38p. (AFCRL-67-0170). CFSTI.

Experimental vlf radio propagation data were to deduce a D-region nitric oxide density profile in the 70 to 90 km height range. (auth) (TAB)

39865 (NP-16939) MAGNETIC AND VELOCITY EFFECTS ON IONOSPHERIC ELECTRON CURRENT TO CYLINDRICAL ELECTROSTATIC PROBES. Miller, Nathan J. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Aug. 1967. 51p.

Thesis.

Ionospheric measurements made with cylindrical electrostatic probes show fluctuations in the current collection due to both the satellite velocity and the earth's magnetic field. These fluctuations represent deviations from the Mott-Smith and Langmuir theory for current collection by electrostatic probes. The present analysis of electron current data from the Explorer 31 satellite probe experiment shows the satellite velocity effects and the magnetic field effects to be resolvable into separate velocity and magnetic field modulations of current which are superimposed upon some constant electron current. After separation, the manner in which each effect arises is explored in a manner consistent with the data. The results indicate that ionospheric electron current measurements in the accelerating region for cylindrical electrostatic probes may contain a velocity modulation which could increase the current by a factor of two or reduce it by one-half. If the velocity modulations are accounted for, the magnetic modulations can cause fluctuations of from 20 to 60% in the remaining current. Since such current measurements are used to deduce ionospheric electron densities, these velocity and magnetically related electron current modulations should be considered in evaluating ionospheric electrostatic probe data. (auth)

39866 STUDIES OF ION-NEUTRAL REACTIONS BY A PHOTOIONIZATION-MASS SPECTROMETER TECHNIQUE. III. SEVERAL IONOSPHERIC REACTIONS. Warneck, Peter (GCA Corp., Bedford, Mass.). Planet. Space Sci., 15: 1349-59 (Sept. 1967).

Several positive ion-neutral reactions of importance in the ionosphere were studied by a photoionization-mass spectrometer technique. These include reactions of O^+ ions with molecular oxygen and nitrogen, N_2^+ and N^+ ions with molecular oxygen and O_2^+ ions with molecular nitrogen and NO. Values of the associated rate coefficients are presented and compared with those obtained by other workers using different methods. The results indicate that these reactions are temperature independent. (auth)

39867 POLARIZATION CHARACTERISTICS OF Pc 1 MICROPULSATIONS AT COLLEGE. Heacock, R. R.; Hessler, V. P. (Univ. of Alaska, College). Planet. Space Sci., 15: 1361-74 (Sept. 1967).

Polarizations of Pc 1 ($T \sim 1$ to 5 sec) micropulsations were recorded intermittently at College from September 1965 to November 1966 by (1) photographing an x-y storage oscilloscope during the event, and by (2) recording the two horizontal components on FM magnetic tape with subsequent playback into the x-y scope. The characteristics of the data suggest that both right-hand and left-hand polarized waves are simultaneously present. Some events had persistent sense, right or left. The structured Pc 1 polarization data and sonagrams are consistent with the concept of an interhemisphere-reflecting packet of hydromagnetic waves, but do not give direct support to theories which require that the packet propagates in L mode. (auth)

39868 ENERGY CHANGES OF COSMIC RAYS IN THE SOLAR SYSTEM. Jokipii, J. R.; Parker, E. N. (Univ. of Chicago). Planet. Space Sci., 15: 1375-86(Sept. 1967).

The energy (in the fixed frame of reference) of a cosmic-ray particle with velocity w in the frame of the solar wind fluctuates between $\frac{1}{2}M(w + v)^2$ and $\frac{1}{2}M(w - v)^2$ as the particle random walks in the magnetic field, where v is the wind velocity. This energy change cannot be treated as a simple Markov process, together with the random walk and adiabatic deceleration, in a fixed frame of reference. To describe the particle motion by a Fokker–Planck differential equation, the energy variable must be the particle energy in a frame of reference moving with the wind. The appropriate transformations of both the solutions and boundary conditions are presented to order v/w. The corrections due to this effect are ~10% for 1 MeV particles and correspondingly less for higher energy particles. The energy balance between the solar wind and cosmic rays is examined and is shown to depend in a fundamental manner on these energy transformations. Although the solar wind does net work on the cosmic-ray gas, no particle gains more than 2 Mvw kinetic energy and the few particles which penetrate deeply into the solar system suffer a net energy loss because of adiabatic deceleration. (auth)

39869 MIDLATITUDE F-REGION DENSITIES AND TEMPERATURES AT SUNSPOT MINIMUM. Evans, J. V. (Massachusetts Inst. of Tech., Cambridge). Planet. Space Sci., 15: 1387-1405(Sept. 1967).

Results obtained for F-region densities and temperatures using the Millstone Hill Ionospheric Radar for the year 1964 are presented. The measurements were made during 30-hr periods which followed at intervals of about 2 weeks throughout the year. The data obtained in each month were averaged to yield a mean electron density profile and mean ion and electron temperature curves for each hour in the day. These curves were in turn used to construct plots showing contours of constant temperature and density as functions of altitude and time for each month. In addition, the annual variation of the midday and midnight densities and temperatures was obtained. The seasonal anomaly in the F-region peak electron density is evident though less pronounced than at years of high sunspot number. The F-region layer thickness undergoes a smooth transition from winter to summer, being greatest in summer. It is shown that the daytime temperatures exhibit no marked seasonal dependence, and hence temperature effects (e.g., on reaction rates) cannot be invoked as the cause. The most striking nighttime phenomenon is the high electron temperature encountered in winter ($T_e/T_i \sim 2.0$) compared with summer. Evidence is presented for the existence of a flux of fast photoelectrons arriving from the conjugate ionosphere. The nighttime heating of the F region is thought to be caused by heat conducted down from the protonosphere together, in winter months, with the flux fast photoelectrons from the conjugate hemisphere. (auth)

39870 OBSERVATIONS AND THEORIES OF THE VLF EMISSIONS. Kimura, Iwane (Kyoto Univ.). Planet. Space Sci., 15: 1427-62(Sept. 1967).

Recent observations made on the ground and by satellites have revealed a variety of vlf emissions. Results of these observations are reviewed. The intensity, diurnal and seasonal variations are summarized, paying particular attention to chorus and hiss, and characteristics of these two kinds of emissions are compared with other geomagnetic phenomena. Apparent differences are found between these two kinds of emissions, suggesting that the generating mechanisms are greatly different. Characteristics of artificially stimulated emissions (ASE), one of which is offset phenomenon, and those of quasiperiodic emissions are described in detail. Theoretical interpretations for the mechanism of vlf emissions are surveyed. Generally, there are three main theoretical categories; noncoherent radiations, coherent beam wave interactions and radio emissions from a plasma wave. The first are radiations from drifting single particles, the intensity of which is, however, insufficient in comparison with that of the observed emissions. The second deals with instabilities for whistler wave mode which may arise at the gyroresonance condition in a plasma beam system and may be the most promising mechanisms for the generation of intense vlf emissions. The third consists of wide band radio emissions excited by hydromagnetic shock waves, which may be a mechanism of hiss. The frequency versus time spectra of each kind of vlf emissions are discussed, which are the crucial properties for classification of the emissions. It is concluded that the theories of beam wave interaction are not yet complete to the point of interpretation for every fine spectral structure. Theoretical interpretation for the offset phenomenon of ASE is proposed, which is based on cyclotron instability by an electron beam. The quasiperiodic emissions may be understood as being produced by a sequence of offset effects. Energies of the beam particles (e.g., electrons or protons) required for gyroresonance and the frequency of emissions to be generated are calculated for geocentric distances, under appropriate assumptions. Then the energies of the particles needed for the generation of chorus and hiss are evaluated. (auth)

39871 EFFECT OF THE STARFISH HIGH ALTITUDE NUCLEAR EXPLOSION ON THE F2 LAYER. Whitten, R. C. (Stanford Research Inst., Menlo Park, Calif.); Dalgarno, A. Planet. Space Sci., 15: 1419-26(Sept. 1967).

The effect of a high-altitude nuclear explosion such as the Starfish burst of July 9, 1962, on the electron loss rate in the F2 layer is discussed. A method for computing the electron density profile at various times after detonation is developed and the results are compared with available observations. The electron loss rate implied by the observations is larger than that of the undisturbed atmosphere, and it is suggested that a substantial part of the enhancement can be attributed to the production of vibrationally excited N_2. (auth)

39872 OBSERVATIONS ON THE SCATTERING OF RADIO-WAVES DURING THE PARTIAL SOLAR ECLIPSE ON 20 MAY 1966. Garg, V. K. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys., 5: 137-8(Apr. 1967).

The scattered signals are generally received during the night hours when the electron density in the ionospheric region is low. It was observed, during the solar eclipse, that the scattered signals appear during the day when the electron density is gradually reduced. The sequence of the variation of the scattered signals near the peak hour of the eclipse indicates that there are patches of electron clouds which form the scattering centers in the F2 layer of the ionosphere and are masked due to high electron density during the day. (auth)

39873 ELECTRON DENSITIES AND SCALE HEIGHTS IN THE MID-LATITUDE TOPSIDE IONOSPHERE. Dyson, P. L. (Univ. of Melbourne). Aust. J. Phys., 20: 401-5(Aug. 1967).

The diurnal and latitudinal variations of electron density and plasma scale height in the topside ionosphere during summer and winter have been calculated from Alouette I ionograms recorded at Woomera. The electron density behavior is anomalous in that the winter nighttime values are generally as large or larger than those occurring during the day. At heights near 1000 km the winter nighttime values are greater than those for nighttime summer. The behavior of the scale height is very similar to that reported by others for the mid-latitude region of the northern hemisphere and implies that at nighttime the transition level from O^+ to lighter ions occurs at heights of about 550 km in summer and 500 km in winter. (auth)

39874 IONOSPHERIC ABSORPTION STUDIES BASED ON COSMIC NOISE DATA AT 28.6 MHz AT BANGALORE. Krishnamurthi, M.; Subrahmanya Sarma, S. B. S. (National Physical Lab., New Delhi). Aust. J. Phys., 20: 455-62(Aug. 1967).

Using a fairly narrow beam antenna (10.5° by 16.5°), cosmic radio noise at 28.6 MHz was continuously recorded during the years 1962–64. The data between midnight and 06 hr local time were used to determine the "unabsorbed cosmic noise intensity" for different sidereal times. Based on this, the total ionospheric absorption at this frequency was computed for the rest of the day. Diurnal and seasonal variations are discussed. The electron-density and collision-frequency profiles obtained by ionosonde, rocket, and incoherent backscatter techniques for various low latitude stations for the height range 40 to 800 km were used to assess the relative contributions to the ionospheric absorption by different regions of the ionosphere. It is shown that at this frequency nearly half of the absorption is due to the topside ionosphere, a third is due to the F2 layer, and the remainder is due to the lower regions, both D and E regions contributing almost equally. The ionospheric absorption during the late evening hours before midnight was found to be closely correlated with f_0F2. It is shown that the total absorption during the rest of the day could be expressed as $A = b(f_0F2)^2 + cf_{min}^{-2} + d$. (auth)

39875 A METHOD OF OBTAINING THE MEAN ELECTRON COLLISION FREQUENCIES IN THE F2 LAYER FROM COSMIC NOISE ABSORPTION STUDIES. Krishnamurthi, M.; Subrahmanya Sarma, S. B. S. (National Physical Lab., New Delhi). Aust. J. Phys., 20: 463-5(Aug. 1967).

Results from previous investigations of the total ionospheric absorption of cosmic noise are used to determine the mean electron collision frequencies in the F2 layer. Monthly values of mean collision frequency are tabulated for the period between August 1962 and April 1964. An approximate estimate of the mean collision frequency for the F2 layer is compared with results of earlier investigations. (J.H.M.)

39876 TOPSIDE REFRACTIVE IRREGULARITIES AND TRAVELLING IONOSPHERIC DISTURBANCES. Dyson, P. L. (Univ. of Melbourne). Aust. J. Phys., 20: 467-9(Aug. 1967).

A sequence of topside ionograms, which were recorded at Woomera from the Satellite Alouette I and in which a number of the ionograms exhibit refractive effects, is shown. For each of the ionograms electron density profiles were calculated using a lamination method. The results show that a large distortion in the electron density contours exists near the peak of the F2 layer. The distortions in the electron density contours are similar to those found by Munro (1950) to be associated with traveling ionospheric disturbances observed below the peak of the F2 layer. (J.H.M.)

39877 THE POSSIBILITY OF RECORDING THE "GAMMA AURORA" EFFECT OF THE HIGH-ALTITUDE BURST OF JULY 9, 1962, BY RIOMETRIC STATIONS IN ALASKA AND WESTERN SAMOA. Kozlov, S. I. Kosm. Issled. Akad. Nauk SSSR, 5: 225-30(Mar.-Apr. 1967). (In Russian).

The possibility of recording the "gamma aurora" effect resulting from the high-altitude thermonuclear burst of July 9, 1962, over Johnston Island by the riometric stations in Alaska and Western Samoa (Apia) is examined. At the precise time of the burst, Kosmos 5 was in orbit some 7500 km away from the burst at a height of 1442 km. The satellite suceeded in recording the flash of hard (gamma) radiation during a two-minute period. The regions of maximum radiowave absorption for the stations in Alaska and Apia at the time of the burst were outside the zone of direct visibility from the point of detonation. It is shown that the riometric stations in Alaska were unable to record the "gamma aurora" effect, since the gamma radiation of the fission fragments ejected during a short time into the zone of direct visibility only slightly ionized the atmosphere above the Alaskan stations. Atmospheric ionization was determined by integrating the kinetic equations containing the function of the rate of electron formation by the gamma quanta fragments for specified initial conditions. The absorption that was observed in Alaska during the burst was caused by the action of another ionizing agent. It was possible to record the "gamma aurora" effect in Apia even though not all of the absorption observed could be attributed to the ionizing effect of the gamma radiation of the fragments. (ATD)

39878 IONOSPHERIC WAVEGUIDE DUCTS FOR LONG-DISTANCE RADIO COMMUNICATION BELOW THE MAXIMUM OF THE F2 LAYER. Danilin, V. A. Kosm. Issled. Akad. Nauk SSSR, 5: 231-9(Mar.-Apr. 1967). (In Russian).

Results of a study of the propagation of short waves emitted by satellites and an analysis of round-the-world echo signals indicate that the mechanism of the near-to-earth propagation of waves cannot always apply to long-distance radio links. Some have pointed to the ionospheric sublayer duct as a possible mechanism of long-distance short-wave propagation. E. Khvoykova (J. Atmosph. Terr. Phys., 16, 124, 1959), during an analysis of radiowave refraction from cosmic sources in a concentrically layered medium, discovered that the integral determining the refraction is divergent for the ionospheric layer with a smooth increase of electron concentration. In such a case, the refraction equal to infinity corresponds to the radio-beam circulation around the earth at a certain altitude. It is shown in the present article that this phenomenon reflects the geometrical-optics situation in the ionospheric sublayer duct. The modified dielectric constant (ϵ_{mod}) is introduced for a concentrically layered ionosphere; the space from the earth's surface up to the maximum-ionization level of the F2 layer is thereby considered (in the first approximation) to be plane-laminated. An analysis of ϵ_{mod} for the ionospheric profile N(h) in the short and ultrashort wave ranges leads to the conclusion that regions exist in the ionosphere which "capture" radio beams emanating from a radiating source or from ionospheric waveguides. It is therefore concluded that the construction of the dependence of ϵ_{mod} on an arbitrary profile N(h) permits establishment of corresponding mechanisms for long-distance radio links without any computation of radiowave paths. The waveguide theory approach to the propagation of radio waves explains (1) the slow drop of the satellite field intensity at a long distance from the receiving point, (2) the antipode effect in the earth–ionosphere waveguide, and (3) the reception of signals from a satellite on the surface at frequencies higher than the maximum frequencies used. For above-surface waveguides in the far zone, the field intensity is determined by signals whose paths are located above the strongly absorbing ionospheric layers. Conditions for the lower end of the ultrashort-wave band are especially favorable because for this band the waveguide is located in the region of the maximal electron-concentration gradient in the F2 layer. The stability of the F2 layer in respect to various geophysical factors leads to the assumption that there is a continuous ionospheric duct which permits communication over large distances. (ATD)

39879 ROLE OF CORPUSCULAR RADIATION IN FORMATION OF THE LOWER IONOSPHERE. Tulinov, V. F. Kosm. Issled. Akad. Nauk SSSR, 5: 240-4(Mar.-Apr. 1967). (In Russian).

Results of measurements of charged particles made with meteorological rockets at heights up to ~100 km are presented. The measuring equipment consisted of three SBT-9 Geiger counters with an input window thickness of 1 mg/cm^2. The counters were capable of registering electrons and protons with energies higher than 35 to 40 keV and 0.5 MeV, respectively, and also cosmic rays. Pulses at the counter outputs were amplified, shaped and applied to integrating circuits whose outputs consisted of dc signals proportional to the radiation intensity. One of the counters was used to register cosmic "noise" and the remaining two were positioned in opposite directions so that data could be collected during both the ascent and descent of the rockets. The collected data showed that radiation intensity registered by the noise counter remains constant at heights above 55 to 60 km; the other two counters, which registered soft radiation during the ascent and descent, showed a significant increase in the radiation intensity above 70 to 75 km. Calculations showed that electrons can be the principal factor of ionization at heights of 70 to 90 km. (ATD)

39880 METHOD FOR THE DETERMINATION OF THE ION TEMPERATURE ACCORDING TO THE CURRENT VARIATIONS IN AN IONIC TRAP AND EVALUATION OF THE MAXIMUM IONIC TEMPERATURE AT ≤10,000 km ACCORDING TO THE DATA FROM ELECTRON-2. Gringauz, K. I.; Bezrukikh, V. V.; Breus, T. K. Kosm. Issled. Akad. Nauk SSSR, 5: 245-50(Mar.–Apr. 1967). (In Russian).

It is demonstrated that the ion temperature can be determined by changes in the collector current of an ion trap (mounted on a satellite rotating in the ionosphere) with a zero potential on the external grid. When the position of the trap with respect to the axis of spacecraft rotation is arbitrary, the position of the normal to the trap collector should change periodically with respect to the velocity vector of the spacecraft, which in turn will cause corresponding periodic changes (modulations) of the recorded collector current. Such a modulation of collector currents was in fact observed during passage of the Luna-2 and Elektron-2 spacecraft through the Earth's plasma envelope. Assuming that maximum collector of such an ion trap occur when the normal to the collector coincides with the velocity vector of the spacecraft, and that minimum collector currents occur when the trap is in the ion shadow in which the direction of the normal to the collector is opposite to that of the velocity vector, the upper limit of the ion temperature can be determined from the ratio of these currents. Such an estimate of the ion temperature limit, based on data from the ion trap carried by the Elektron-2 spacecraft, showed that at altitudes of 4000 to 8000 km the ion temperature did not exceed 10,000°K. (ATD)

39881 SOLAR WIND OBSERVATIONS BY THE VENUS-3 SPACE PROBE. Gringauz, K. I.; Bezrukikh, V. V.; Musatov, L. S. Kosm. Issled. Akad. Nauk SSSR, 5: 251-8(Mar.-Apr. 1967). (In Russian).

Preliminary results are presented of measurements of the energy spectra of positive ions in solar plasma winds, made by a modulation trap aboard the Venus-3 spacecraft during the period from November 16, 1965, to Janaury 7, 1966. The modulation trap was of the type used on the Zond-2 space probe. The following are some of the characteristics of the trap. When the normal to the trap was oriented along the plasma stream, the positive ion streams were measured in eight successive energy intervals, each approximately 450 eV wide; as a result, the maximum recorded energy of particles was 3600 eV. Four minutes were required to obtain a single energy spectrum. The sensitivity in each energy interval was 10^7 cm$^{-2}\cdot$sec^{-1}. All measurements were made under conditions in which the normal to the trap formed an angle of 10° with the Sun–spacecraft vector. A study of the energy spectra of positive ions thus obtained has yielded the following conclusions. As a rule the largest ("main") components of the spectrum were observed in the intervals corresponding to velocities not exceeding 510 km/sec. The recorded ion streams varied between 15×10^8 cm$^{-2}\cdot$sec^{-1} and 2×10^9 cm$^{-2}\cdot$sec^{-1}. It is noted that the results of determining the ion streams and the velocities of the solar wind by means of the ion trap are in good agreement with those obtained by U.S. space probes with instruments based on the same principle. (ATD)

39882 INVESTIGATION OF RECORDING DEVICES USED FOR MEASURING UV RADIATION IN THE UPPER ATMOSPHERE AND COSMIC SPACE. Tilt, V. M.; Kurt, V. G.; Katyushina, V. V. Kosm. Issled. Akad. Nauk SSSR, 5: 280-4(Mar.-Apr. 1967). (In Russian).

A description is given of the vacuum diffraction ultraviolet monochromator for investigation of the spectral sensitivity of radiation recorders (photomultipliers, photon counter, ionization chambers). A circulating hydrogen tube was used as the light source. The recording scheme guaranteed the recording of the ratio of the signal of the devices investigated to signals of supporting photomultipliers on the cathodes of which was deposited sodium salicylate. The comparison of the photomultiplier with the vacuum thermocouple made it possible to accomplish an absolute calibration of the radiation detectors. (tr-auth)

39883 IONOSPHERIC WAVE THEORY USING COUPLED VACUUM MODES. Poeverlein, H. (Air Force Cambridge Research Labs., Bedford, Mass.). Radio Sci., 2: 905-11(Aug. 1967).

In coupled-mode theory the wave field in a stratified anisotropic medium appears decomposed into modes, which are coupled in accordance with a set of coupled wave equations. The modes can be defined in various ways. In the conventional formulation they correspond to waves in a homogeneous magnetoionic medium; the present theory uses modes of vacuum propagation characteristics. The coupled wave equations for these vacuum modes have a fairly simple form. The effect of the medium appears in the coupling matrix, whose elements contain a number of terms depending on the various parameters of the medium. The coupled wave equations, originally obtained from a study of partial reflection at differential slabs of the medium, are now derived in two different ways, both rather direct. In one derivation the vector potential is split into ascending and descending parts. The other derivation adheres to the matrix formalism of the conventional coupling theory as far as possible, thus indicating the essential deviations from the conventional theory. The vertical energy flux densities of the modes are expressed in terms of the field quantities used. (auth)

39884 IMPROBABILITY OF NONTHERMAL RADIO EMISSION FROM VENUS WATER CLOUDS. Drake, F. D. (Cornell Univ., Ithaca, N. Y.). Astrophys. J., 149: 459-64(Aug. 1967).

Plummer and Strong (1966) have suggested that perhaps a significant fraction of the Venus microwave emission is due to electrical discharges within the Venus clouds and, consequently, the temperatures inferred from the emission are too high. This suggestion is criticized and an answer to the criticism is given by Plummer and Strong. (W.D.M.)

39885 MORPHOLOGY OF JUPITER'S DECAMETRIC RADIO SOURCES. Smith, Alex G.; Lebo, G. R.; Carr, T. D. (Univ. of Florida, Gainesville. Univ., Chile, Santiago de Chile). pp 318-36 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

In late 1956 the University of Florida began systematic monitoring of the decametric radio emission from Jupiter. The initial observations were made at 18 Mc; but the instrumentation was rapidly expanded, and at present, regular observations are made at eleven frequencies in the range from 5 to 53 Mc from two stations in Florida, two stations in Chile, and Arecibo. Results of these observations are given. (W.D.M.)

39886 TIME STRUCTURE OF JUPITER'S DECAMETRIC EMISSION. Douglas, James N. (Yale Univ., New Haven). pp 337-42 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

The sporadic and fluctuating character of Jupiter's decametric emission has been obvious since the discovery observations. What has not been clear is the extent to which time variations are intrinsic in the source. The present contribution reviews evidence that some components of the time variation of flux and polarization are due to rotation of Jupiter's magnetic field, interaction with the satellite Io, and irregular diffraction effects arising in the interplanetary medium. (W.D.M.)

39887 PLANETARY MODULATION OF GEOMAGNETIC ACTIVITY. Jacobs, J. A.; Atkinson, G. (Univ. of British Columbia, Vancouver). pp 402-14 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Two sets of statistics are available on the modulation of geomagnetic activity by the planets, both of which are thought to be statistically significant. Houtgast and Van Sluiter's (1962) statistics show a decrease at inferior conjunction of Venus, and maxima at Mach angles of 5 or 6°. Their results did not include sufficiently large angles to look for outer maxima as found in Biggs' work. Biggs' (1963b) work indicates decreases at inferior conjunctions of Venus and Mercury and maxima at Mach angles around 3.5 and 23°. This includes blue clearing frequencies at Mars, which exhibit exactly the opposite tendencies, viz., a maximum when the Earth is at inferior conjunction as seen from Mars, and minima at the above angles. (W.D.M.)

39888 RADIOCARBON AND PALEOMAGNETISM. Libby, W. F. (Univ. of California, Los Angeles). pp 60-5 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

The possible disturbances in the radiocarbon content of living matter which could cause significant error in radiocarbon dates fall into two classes: disturbances of the rate of production by cosmic rays, and disturbances of the mixing reservoir of exchangeable carbon with which the radiocarbon produced in the high atmosphere is mixed in the lifetime of radiocarbon. It is shown that of all the possible disturbances, paleomagnetism is the one most likely to have been important. (W.D.M.)

39889 THE INFLUENCE OF GEOMAGNETIC SHIELDING ON ^{14}C PRODUCTION AND CONTENT. Ramaty, Reuven (Univ. of California, Los Angeles). pp 66-78 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

The variation of the ^{14}C content with a varying geomagnetic field was first considered by Elasser et al. (1956). They found a production rate variation proportional to $M^{-0.5}$, where M is the geomagnetic dipole moment. Since the production rate calculation of Lingenfelter (1963) is dependent on latitude, the variation of the production rate is recalculated in a more accurate fashion. A two-reservoir model for the exchangeable terrestrial carbon is considered. Using this model, the ratio between the ^{14}C decay rate at any time to that at the present is evaluated as an integral depending on the production rate variation between the present and the time considered. Using this result, the response of the ^{14}C content to periodic, as well as exponentially varying, production rates is calculated. The question of the nonequality between the present production and decay of ^{14}C is considered in connection with the geomagnetic variations; and finally, paleomagnetic measurements are used to determine the corresponding ^{14}C content variations. (W.D.M.)

39890 21.2 cm OBSERVATIONS OF THE PLANETS VENUS, MARS, JUPITER, AND SATURN. Davies, R. D.; Williams, D. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). pp 288-91 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

The continuum emissions from Venus, Mars, Saturn, and Jupiter were studied at 21.2 cm in an effort to extend spectral observations from cm to dm wavelengths. The planets were observed with a double-beam system which measured their intensities with the E vector at position angle 0°. Calibration of intensity was made by comparison with the radio sources 3C 225, 3C 298, and 3C 446 whose flux densities were taken as 4.30, 5.60, and 5.80 flux units ($\times 10^{-26}$ wm^{-2} $(c/s)^{-1}$). (W.D.M.)

39891 CENTIMETER RADIATION FROM JUPITER AND SATURN. Rose, William K. (Princeton Univ., N. J.). pp 292-5 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

During 1962, Jupiter and Saturn were observed at 9.4 cm. The data were obtained with a solid-state maser amplifier at the focus of the USNRL 84-foot radio telescope. In 1963 and 1964, observations of Saturn were made at 21.2 cm with a pair of superheterodyne receivers at the focus of the NRAO 300-foot radiotelescope. The results of these observations are discussed. (W.D.M.)

39892 MICROWAVE OBSERVATIONS OF JUPITER. Dickel, John R. (Univ. of Illinois, Urbana). pp 296-309 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

The microwave observations of Jupiter show that the magnetic axis of the planet is inclined from the rotational axis by 11.5° with the magnetic pole in the northern hemisphere at λ^{III} 211°. This magnetic axis appears to be somewhat offset from the center of the planet with a longitude of about λ^{III} 190°. In order to produce the observed spectrum, the magnetic field of the planet must be about 0.3 gauss in the radiating magnetosphere. (W.D.M.)

39893 SYNCHROTRON RADIATION FROM JUPITER AT 610 Mc. Barber, D. (Royal Radar Establishment, Great Malvern, Eng.). pp 310-17 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

Several series of observations of the radiation from Jupiter at 610 Mc have been made during the last three years using the radio telescope interferometer at Difford. The aim of the observations carried out at 610 Mc has been a detailed investigation of the degree of polarization of the radiation, the direction of polarization, the periodic variations linked with Jupiter's rotation, and the angular dimensions of the emitting region. An outline of some of the results is given. (W.D.M.)

39894 DAILY VARIATION OF TOTAL MAGNETIC FIELD OVER THE BRITISH ISLES. Riddihough, R. P. (Dublin Inst. for Advanced Studies). Nature (London), 215: 720-2(Aug. 12, 1967).

The use of observatory data as a basis for the correction of diurnal variation in magnetic surveys is common both for secular repeat stations spread over a wide area, and in ground and marine magnetic surveys where limitations of personnel and equipment prohibit the maintenance of a local base. Geographical interpolation of the variations is usually based on local time and latitude, the errors involved being assumed small. Walker (1918), however, stated that such interpolation was incorrect, and it is thought that the matter has received little attention since that date. During the reduction of a total field survey in N.W. Ireland, comparisons between a local diurnal base station and Valentia Observatory suggested that differences were neither small nor clearly dependent on local time, but were nevertheless systematic. It was therefore decided to investigate on a larger scale the interrelationships of the daily variations over the British Isles, with a view to determining whether the common interpolation method did provide agreement with the observations, and to assess errors involved in using it. It was found most convenient to use published observatory data for 1956 and 1957. The figures used were those for the "Mean Diurnal Inequalities." The methods and results of this investigation are discussed. Comparison of the phase and amplitude of the field variations at two stations was made by direct cross multiplication and calculation of the correlation coefficient. A marked difference was found between values obtained for the International Quiet Days of the summer and those for All Days of the year. Within these two categories consistency was fair. The variations of the calculated values indicate that the relationships between stations are by no means constant, but can change considerably in response to factors which at present are impossible to evaluate. Two main features appear to be evident in the contour maps. Firstly, the amplitude of the daily variation of total field decreases eastwards; secondly, the contours of equal phase run approximately NW to SE. Taking the contours for All Days as the norm around which other contour patterns will occur, the pattern contrasts considerably with the accepted "local time" situations. (UK)

39895 LUNISOLAR DAILY VARIATIONS OF THE GEOMAGNETIC FIELD AT TANANARIVE DURING THE INTERNATIONAL GEOPHYSICAL YEAR. Malin, S. R. C. (Royal Greenwich Observatory, Hailsham, Eng.). Nature (London), 215: 719-20 (Aug. 12, 1967).

A program for the analysis of IGY data from magnetic observatories for lunisolar variations has been extended to data from Tananarive observatory, Madagascar. This site is of particular interest since it lies at dip latitude $\varphi = -34.8°$, and no data between $\varphi = -24°$ and $-47°$ have previously been analyzed. In addition, Tananarive is an inland observatory, so that it is unlikely to show an anomalous lunisolar variation in Z, as is the case for coastal observatories. The data consisted of instantaneous values of D, H, and Z measured every 2 hours at odd hours of Universal Time from July 1, 1957, to December 30, 1958, omitting the five International Disturbed Days of each month. The object of the analysis was calculation of the lunisolar daily harmonic l_n and λ_n (the amplitude and phase of l_n). Results are tabulated, and comparison made with data for the British Isles. The distribution of the seasonal values of L_2(D) about the mean is closely similar to that for the British Isles, although the range of nearly 5γ from summer to winter at Tananarive is much greater. L_2(H) also shows a similar pattern to that for the British Isles; in this case, however, the range of the seasonal variation is less at Tananarive than in Britain. L_2(Z) shows a significant increase in amplitude from S to W at Tananarive; its sign is opposite to that for Britain. (UK)

39896 INTENSITY OF THE EARTH'S MAGNETIC FIELD IN THE GEOLOGICAL PAST. Krs, M. (Inst. of Applied Geophysics, Prague). Nature (London), 215: 697-9(Aug. 12, 1967).

A knowledge of the intensity of the geomagnetic field during the geological past is necessary to an understanding of the field itself, as well as to studies of remanent magnetization of rocks and minerals. Data on the spatial distribution of the intensity during various geological periods on individual continents would also provide further much needed data for verifying the continental drift theory. Some naturally occurring materials for determination of the intensity of the Earth's magnetic field in the geological past are discussed, with application of Thellier's archaeomagnetic method of stepwise heating, which requires that the natural remanent magnetization of samples must be of thermo-remanent origin, that the samples must be palaeomagnetically stable, and must not undergo undesirable phase transitions during laboratory heating processes. The first of these materials is cassiterite with iron ions bound to the lattice, which was used to derive the intensity of the geomagnetic field in the Permo-Carboniferous. Some ignimbrites are also suitable, and were used to derive the intensity in the Lower Permian. The best archaeomagnetic samples are stated to be porcellanites, natural baked earths and palaeoslags, and these were used to derive the intensity in the Plio-Pleistocene. It is concluded from the results that the intensity of the geomagnetic field (in Central Europe) during the Permo-Carboniferous, Permian, and Plio-Pleistocene did not differ appreciably from the present-day intensity. (UK)

39897 THEORETICAL NOTES ON WHISTLERS AND PERIODIC EMISSIONS IN THE HYDROMAGNETIC REGIME. Jacobs, J. A.; Watanabe, T. Planet. Space Sci., 15: 799-809(Apr. 1967).

It is contended that there are, at least, two prototypes of Pc 1 micropulsation signals which may be termed hm (hydromagnetic) whistlers and periodic hm emissions. The cyclotron instability process which was suggested as the generation mechanism of hm emissions in general is now proposed only for periodic hm emissions, and not for hm whistlers. In the case of periodic hm emissions, several observational facts remain unexplained on a linear theory of the cyclotron instability process, although some of them may be interpreted as the effects of nonlinearity in the instability. According to the nonlinear instability theory, it is expected that the signal strength of a hm wave does not grow indefinitely as predicted by the linear theory but decays eventually. This gives a possible answer to one of the unsolved problems as to why a hm emission does not appear as a continuous line but as a dot on a spectrogram. Another result of the nonlinear theory is that the frequency of a hm wave is not constant (as in the linear theory) but changes with time. As the wave amplitude grows with time, the frequency increases simultaneously. This may account for another unexplained fact that the frequency of a hm emission increases with time. (UK) (auth)

39898 ION LAYERS IN THE E REGION OF THE IONOSPHERE WITH A LINEAR ATTACHMENT LAW. Whitehead, J. D. (Univ. of Queensland, Brisbane). Planet. Space Sci., 15: 1055-7(June 1967).

The formation of layers of ions in the E region is considered under the conditions that the vertical movement is sinusoidal and that the ions recombine with electrons following an attachment law. Such layers form with maxima more cusp-shaped than parabolic. (auth) (UK)

39899 SIMULTANEOUS MEASUREMENTS OF ELECTRON DENSITY AND TEMPERATURE IN THE NORTHERN AURORAL ZONE. Berthelier, J. J. (Groupe de Recherches Ionospheriques, St. Maur-des-Fosses, France); Sturges, D. J. Planet. Space Sci., 15: 1049-54(June 1967).

Measurements of electron density using an rf capacitance probe, and of electron temperature using a new type of double Langmuir probe, are reported. Data were obtained over an altitude range from about 65 to 240 km, during a moderately strong zenithal aurora. The probes were launched from Andoya, Norway, using a Dragon rocket. (auth) (UK)

39900 D-REGION MEASUREMENTS DURING A SOLAR ECLIPSE. Bowling, T. S.; Norman, K.; Willmore, A. P. (London Univ.). Planet. Space Sci., 15: 1035-47(June 1967).

Observations of positive ion density in the D region during the solar eclipse of May 20th, 1966, were made by means of a cylindrical Langmuir probe carried on a small rocket. The launch site was near Karystos in Greece. The ion density between 70 and 80 km was found to vary rapidly during the eclipse and the main ionizing source at the time is considered to have been an x-ray emitting region on the Sun. From the x-ray intensity of the Sun on this day, the maximum NO concentration at 80 km is found to be 1.8×10^6 cm^{-3}. This is consistent with other D region and some laboratory observations, but not with airglow measurements. Some evidence was also found for day-to-day variations in D-region density not associated with variations either in solar x rays or in atmospheric density. These are presumed to be due to variations in the concentration of a minor atmospheric constituent such as NO, perhaps with atmospheric temperature. (auth) (UK)

39901 THE OCCURRENCE OF AURORAL PULSATIONS IN THE FREQUENCY RANGE 0.01 TO 0.1 cps OVER TROMSO. Omholt, A.; Berger, S. (Auroral Observatory, Tromsoe, Norway). Planet. Space Sci., 15: 1075-80(June 1967).

Optical auroral pulsations in the frequency range 0.01 to 0.1 cps were studied by an automatic zenith photometer. The distribution during the night showed a pronounced peak around 02 to 03 MET, with almost no pulsations occurring before 22 MET (magnetic midnight). There was a peak in the distribution of fundamental frequencies at about 0.04 to 0.05 cps, but no significant frequency variation during the night. The amplitude of the pulsations decreased significantly during the night. There was no detailed correlation between the optical and magnetic pulsations. (UK) (auth)

39902 LONG-TERM ASPECT OF THE SEASONAL VARIATION IN THE NIGHTGLOW 5577 INTENSITY AT MIDDLE LATITUDES. Yano, K. (CSIRO, Camden, Australia). Planet. Space Sci., 15: 1091-3(June 1967).

A large number of observations indicate that the monthly mean intensity of the nightglow 5577 at middle latitudes undergoes three peaks a year, two higher peaks being in midsummer and in autumn, respectively, and another lower one is in early spring. This feature appears to be seasonally coincident fairly well in the northern and southern hemispheres. Attempts have been made by several authors to explain this feature of the intensity variation in terms of the photochemical excitation and atmospheric motions at high altitudes. Although those attempts seem to be successful to some extent, the interpretation should not be regarded as conclusively established, since the excitation mechanism and the dynamical behavior of the upper atmosphere are not fully understood yet. In view of these circumstances, a check of this seasonal feature over a period from sunspot maximum to minimum may be useful for considerations of the rather complex phenomena responsible. Such a check is described. Interpretations of the nightglow 5577 excitation mechanism are reviewed and discussed. (auth) (UK)

39903 REFLECTION OF ELECTROMAGNETIC WAVES FROM STRATIFIED MAGNETOPLASMAS WITH PERTURBED PROFILES. Burman, R. (Victoria Univ., Wellington, New Zealand). Planet. Space Sci., 15: 1059-66(June 1967).

The reflection of electromagnetic waves by a planar stratified magnetoplasma is considered. The profile of the plasma is regarded as being slightly perturbed from a profile for which the field distribution in the plasma is known. Some work of Pitteway (Proc. R. Soc., A246: 556(1958)) is used to obtain approximate formulas which give the effect of the perturbation on the reflection coefficients. Some special cases are considered. (auth) (UK)

39904 POLARIZATION RECEPTION OF RADIO WAVE SCINTILLATIONS. Chytil, Bohumil (Geophysical Inst., Prague). Stud. Geophys. Geod., 11: 304-10(1967).

An expression derived for the mutual correlation function of voltage fluctuations of waves received, after propagating through the ionosphere, by two differently polarized antennae is presented. The polarization properties of reception antennae, the polarization of the original wave, and the geometrical elements of propagation are factors, which correct the hitherto generally used correlation function of field amplitude fluctuations, and allows for the consideration of wave as well as antennae polarization. The correction factor is largely dependent on the geometry of propagation. It seems that it is most convenient to use circularly polarized antennae, which separate the ordinary and extraordinary wave and allow depolarization, as well as the integral effect of the ionosphere on the propagation of both waves, to be investigated. (auth)

39905 LUNAR VARIATIONS IN AURORAL ZONE. Gupta, J. C. (Univ. of California, Los Angeles). Nature (London), 215: 607-8(Aug. 5, 1967).

In an investigation of the frequency content of the geomagnetic record, collected during the IGY/IGC at several stations spread over the globe, it was found that at most of the stations, in addition to the solar harmonics, several lunar tidal lines and lunisolar lines appeared, significantly above the noise level of the spectrum. The amplitudes of these lines were estimated from the power energy of the appropriate peak in the spectrum. The present note considers the variation of the amplitude of the harmonic terms L_1, L_2, and L_3 with respect to the dipole latitude. Simple tidal theory indicates that the diurnal and semidiurnal terms of the lunar tide vary with latitude λ as $\sin 2\lambda$ and $\cos^2 \lambda$, respectively. In the auroral zone, near a latitude of 65°, the values of $\sin 2\lambda$ and $\cos^2 \lambda$ are, respectively, 0.77 and 0.18, and the diurnal term has a favorably high coefficient in this zone. The amplitudes of the resultant harmonic terms were found to be considerably larger in the equatorial and auroral zones. It has been suggested that the large amplitude of the lunar geomagnetic variation in the equatorial zone is due to a lunar equatorial electrojet. On either side of this equatorial electrojet belt the amplitudes of the lines (L_1, L_2, L_3) are small, but there is a sudden considerable increase in their amplitudes within the auroral zone in both hemispheres. Data indicate that the current system responsible for the large lunisolar variations in the auroral zone flows in the same direction as the well-known auroral electrojet. (UK)

39906 EFFECTS OF EXTERNAL SOURCES OF THE MAGNETIC FIELD AT F2-LAYER HEIGHTS. I. Dolginov, Sh. Sh.; Konpvalova, L. V.; Nalivayko, V. I.; Tyurmina, L. O.; Chinchevoy, M. M.; Fatkullin, M. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 757-67(1966).

Translated from Geomagn. Aeronomiya, 6: 969-82(1966).

An analysis is made of the curves of differences $\delta T = \Delta T_i - \Delta T_{i+77}$, where ΔT_i is the difference between the measured and computed field values on the i-th pass and ΔT_{i+77} is the difference between the measured and computed field values on "repeated" satellite passes having similar coordinates φ and λ. The satellite traveled along these orbits with a time shift of 2 hours local time and on days with different magnetic activity. Therefore, the ΔT differences contain information on the external sources of the geomagnetic field. The influence of a homogeneous source above the apogee of the satellite and of sources at flight altitudes is established. The influence of the equatorial electrojet and the possible influence of magnetic field sources at heights of the ionospheric F2 layer are discussed. (auth)

39907 PENETRATION OF THE SOLAR WIND INTO THE GEOMAGNETIC FIELD. Samokhin, M. V. (Inst. of Radio Engineering and Electronics, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 768-73(1966).

Translated from Geomagn. Aeronomiya, 6: 983-90(1966).

The penetration of plasma into the magnetosphere under the effect of drift in crossed electric and magnetic fields is examined. The dimension of the forbidden zone is estimated from the known results of Alfvén–Karlson. The flux is regarded as plane from the dayside of the magnetosphere boundary to the boundary of the forbidden zone and the results of a computation of density distribution are compared with experimental data. A supersonic expansion of flow in the magnetosphere tail is predicted. The condition of transition through the critical cross section is used to determine the rate of penetration into the magnetosphere and the dimension of the forbidden zone, which agree with the experimentally observed location of the discontinuity in the ion density distribution curve. It is shown that the assumption that the solar wind penetrates into the magnetosphere does not contradict experimental data on the structure of the magnetic field in the magnetosphere tail. (auth)

39908 DISTRIBUTION OF THE CONCENTRATION AND DENSITY OF A PARTICLE FLUX IN THE VICINITY OF A SMALL BODY MOVING IN A RAREFIED PLASMA. Knyazyuk, V. S.; Moskalenko, A. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 779-86(1966).

Translated from Geomagn. Aeronomiya, 6: 997-1007(1966).

The results are reported of computations of the concentration and density of a flux of attracted particles in the vicinity of a body moving in a plasma. The plasma is assumed to be strongly rarefied and the dimension of the body to be small compared with the Debye radius. Various body velocities and potentials are examined. (auth)

39909 ASYMPTOTIC BEHAVIOR OF THE TRAIL OF A BODY MOVING RAPIDLY IN A RAREFIED PLASMA. Bud'ko, N. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 787-90(1966).

Translated from Geomagn. Aeronomiya, 6: 1008-12(1966).

An analytical solution is given to the problem of the distribution of charged particles at great distances in the trail of a body moving rapidly in a rarefied, unmagnetized plasma. The angular distribution of particles in the trail is represented as the sum of contributions by branches of ion–acoustic plasma waves. (auth)

39910 REFLECTION OF PULSE SIGNALS FROM AN INHOMOGENEOUS IONOSPHERE IN TOPSIDE SOUNDINGS. Zhekulin, L. A.; Namazov, S. A.; Dobryakova, F. F. (Inst. of Radio Engineering and Electronics, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 795-9(1966).

Translated from Geomagn. Aeronomiya, 6: 1019-24(1966).

A method of computing the distortion of a pulse envelope of arbitrary shape on reflection from an inhomogeneous ionospheric plasma is discussed. (auth)

39911 PLANETARY DISTRIBUTION OF THE VARIABILITY OF MAXIMUM ELECTRON DENSITY IN THE F2 LAYER. Potapova, N. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 800-4(1966).

Translated from Geomagn. Aeronomiya, 6: 1025-31(1966).

Maps are presented of the coefficient of variation of maximum electron density in the F2 layer ($vN_m F2$) for three seasons during the IGY and IQSY, based on data from stations located at longitudes 75 to 100°W and 70 to 150°E. Maps are constructed for the same periods from data grouped by inclination. The principal properties of the distribution of $vN_m F2$ are obtained. A narrow region is found with greatly enhanced $N_m F2$ variability in the hours after sunset and at night in the vicinity of I = 30 to 35°. The behavior of vN_m in this region depends on the season and solar activity. (auth)

39912 SOME RESULTS OF STUDIES OF SPREAD F OVER A SOLAR ACTIVITY CYCLE AT MURMANSK. Katsenel'son, I. B. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 805-7(1966).

Translated from Geomagn. Aeronomiya, 6: 1032-5(1966).

Studies of spread-F over a solar activity cycle have demonstrated that its frequency of appearance changes with increasing solar activity. There is a maximum in the frequency of spread-F in years of moderate solar activity (1956 and 1960). The results obtained on the diurnal and seasonal appearance of spread-F and their relation to magnetic activity suggests that spread-F are predominantly of corpuscular origin. (auth)

39913 RELATIONSHIP BETWEEN IONIZATION IN THE F2 LAYER AND THE INCIDENCE OF SOLAR WAVE RADIATION ACCORDING TO OBSERVATIONS AT YAKUTSK. Mamrukov, A. P. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 808-11(1966).

Translated from Geomagn. Aeronomiya, 6: 1036-40(1966).

The results are reported of a study of the relationship between the noon critical frequencies of the F2 and E layers of the ionosphere and the total daily incidence of solar wave radiation in the Earth's atmosphere for the period 1957–1964 according to observations at Yakutsk. (auth)

39914 STUDY OF $h'E_s$ AND f_0E_s VARIATIONS. Ovezgel'dev, O. (Dept. of Exploration Geophysics and Seismology, Ashkhabad, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 812-15 (1966).

Translated from Geomagn. Aeronomiya, 6: 1041-6(1966).

The results are reported of a study of diurnal and short-period $h'E_s$ and f_0E_s variations. The amplitude of the short-period $h'E_s$ variation ranges from 0 to 5 km and that of the short-period f_0E_s variation reaches 5 to 6 MHz. (auth)

39915 EXPERIMENTAL VERIFICATION OF THE SUITABILITY OF THE PARABOLIC MODEL OF THE IONOSPHERE FOR OBLIQUE SOUNDING. Chernov, Yu. A. Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 816-18(1966).

Translated from Geomagn. Aeronomiya, 6: 1047-50(1966).

The results of oblique sounding at various hours of the day in the spring and summer of 1962 and 1963 are examined. It is shown that satisfactory agreement with computed distance is obtained when using a parabolic layer model with a semithickness of 100 km. The height of the ionization maximum can be determined reliably from a series of experiments if the critical frequency at the reflection point is known. (auth)

39916 DETERMINATION OF THE DAYTIME ELECTRON CONCENTRATION PROFILE OF THE C AND D REGIONS OF THE IONOSPHERE FROM MEASUREMENTS OF THE SURFACE FIELDS OF ULTRALONG RADIO WAVES AND FROM THE ATMOSPHERIC PRESSURE PROFILE. Baybulatov, R. B.; Krasnushkin, P. E. (Inst. of Mathematics, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 819-27(1966).

Translated from Geomagn. Aeronomiya, 6: 1051-60(1966).

A method of optimizing the problem of coordinating data on the fields of low-frequency radio waves and ionospheric properties is described. This method makes it possible to find the electron concentration profile, $N_e(h)$, of the lower ionosphere by means of a multistep search on an electronic computer using data on the surface fields of ultralong waves and the collision frequency profile for electrons, $\nu(h)$. The new data on the transport frequency of collisions are used to refine the daytime summer profile of the C region at middle latitudes. (auth)

39917 STUDY OF THE SPACE AND TIME DISTRIBUTION OF AURORAL ABSORPTION ACCORDING TO OBSERVATIONS OF THE RIOMETER NETWORK IN THE ARCTIC. Driatskii, V. M. (Arctic and Antarctic Scientific Research Inst., Leningrad). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 828-34 (1966).

Translated from Geomagn. Aeronomiya, 6: 1061-70(1966).

Cosmic-noise records at arctic stations are used to analyze the latitudinal distribution of auroral absorption during minimum solar activity and to determine the influence of geomagnetic disturbance on the absorption level. A comparison is made with the latitudinal distribution of auroras and with absorption in other longitudinal regions at high latitudes. The diurnal pattern of auroral absorption is analyzed and ideas are advanced regarding the nature of the patterns obtained. (auth)

39918 FIELD OF DRIFT CURRENTS OF THE RADIATION BELT. Bryunelli, B. E. (Leningrad State Univ.). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 839-43(1966).

Translated from Geomagn. Aeronomiya, 6: 1076-82(1966).

Simple relationships are derived for estimating the magnitude of the field of the main phase of a magnetic storm. It is assumed that the plasma pressure can remain constant or change in proportion to the magnetic pressure. The ratio of both pressures is estimated from the difference between the measured field induction and the computed intensity. Cases of isotropic and anisotropic velocity distribution are analyzed. The computed field values can exceed the values found by Akasofu and Chapman. (auth)

39919 ENERGY OF A MAGNETIC STORM. Bryunelli, B. E.; Pudovkin, M. I. (Leningrad State Univ. Polar Geophysical Inst., Kola, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 844-8(1966).

Translated from Geomagn. Aeronomiya, 6: 1083-8(1966).

The form of a formula for computing the energy of a magnetic storm is discussed. Expressions are given for computing the magnitude of magnetic energy in a system containing a conductive screen and the increment of the kinetic energy of particles during the formation of a ring current in the case of isotropic and anisotropic velocity distribution. (auth)

39920 STABLE GEOMAGNETIC MICROPULSATIONS AND SOLAR CORPUSCULAR STREAMS. Bol'shakova, O. V. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 849-51(1966).

Translated from Geomagn. Aeronomiya, 6: 1089-93(1966).

Each type of solar corpuscular radiation from undisturbed regions of the Sun, from active regions, and from chromospheric flares is associated with a definite type of geomagnetic pulsation. The conclusions that streams producing these pulsations have a different geometry and that the intensity level of different types of radiation changes in the solar activity cycle are derived from a study of the morphological properties of these types of pulsations. (auth)

39921 IRREGULAR VARIATIONS OF THE SPEED OF ROTATION OF THE EARTH AND THE EFFECT OF SOLAR CORPUSCULAR STREAMS ON THE TAIL OF THE GEOMAGNETOSPHERE. Afanas'eva, V. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 852-3(1966).

Translated from Geomagn. Aeronomiya, 6: 1094-5(1966).

Equations are presented in an attempt to express how the Earth's rotation is influenced by the action of solar corpuscular streams on the magnetosphere. (J.H.M.)

39922 VERTICAL IONIZATION DRIFT IN THE F REGION OF THE IONOSPHERE. Mizun, Yu. G. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 867-8(1966).

Translated from Geomagn. Aeronomiya, 6: 1110-11(1966).

An examination was made of the variations of the virtual height of the base of the F region and of the critical frequency of the F2 layer during the disturbed periods of March 22–30, June 5–17, and October 21–31, 1958, according to data of ionospheric stations located in the vicinity of the geomagnetic meridian 0 to 180°. Variations of height of F region and critical-frequency anomalies were observed on the day of commencement, before the sudden commencement, and during the main phase of a magnetic storm. Data from these observations are plotted. (J.H.M.)

39923 VARIABILITY OF THE N(h) PARAMETERS DURING THE IGY AND IQSY. Potapova, N. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 868-70(1966).

Translated from Geomagn. Aeronomiya, 6: 1112-13(1966).

Time variations of the values of the variability characteristic of various parameters of the vertical N(h) profiles of the ionosphere are considered. (J.H.M.)

39924 RELATION OF ELECTRON CONCENTRATION AT HEIGHTS OF 100 AND 110 KM TO GEOMAGNETIC FIELD DISTURBANCE. Korsunova, L. P.; Ivanov-Kholodnyi, G. S.; Kazachevskaya, T. B.; Mishin, V. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Novosibirsk, USSR. Inst. of Applied Geophysics, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 871-2(1966).

Translated from Geomagn. Aeronomiya, 6: 1114-15(1966).

The effects of magnetic activity on electron concentration at heights of 100 and 110 km in the lower part of the ionospheric E region are considered. The electron concentration values were taken from the data of rocket experiments conducted at middle latitudes from 1947 to 1963. (J.H.M.)

39925 DETERMINATION OF THE SPEED OF VERTICAL MOTION OF THE LOWER IONOSPHERE. Yampol'skii, V.; Rzhevtsev, V. (Omsk Pedagogical Inst., USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 873-4(1966).

Translated from Geomagn. Aeronomiya, 6: 1116-17(1966).

The method of spectral analysis of the field intensity of radio waves as a function of time is used to measure the speed of the vertical movement of the lower regions of the ionosphere. A formula is given for determining the speed of the vertical movement of the ionosphere with allowance for the sphericity of the Earth. (J.H.M.)

39926 NUMBER OF RETURN SIGNALS WITH REFLECTION FROM THE F2-LAYER IN OBLIQUE SOUNDING. Chernov, Yu. A. Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 874-6 (1966).

Translated from Geomagn. Aeronomiya, 6: 1118-19(1966).

To facilitate the interpretation of oscillograms from oblique soundings and to study depolarization upon scattering, the number of possible signals to be expected in some area of the distance scale must be known. A method for determining the number of return signals with reflection from the F2 layer is discussed. The method also relates to the other ionospheric layers, particularly to F1. (J.H.M.)

39927 DRIFT OF SMALL-SCALE INHOMOGENEITIES AT MIRNY (THE ANTARCTIC). Kashin, A. A.; Klimanov, F. P.; Kushnerevskii, Yu. V.; Mirkotan, S. F.; Nerovnya, L. K. (Moscow State Univ. Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 876-8(1966).

Translated from Geomagn. Aeronomiya, 6: 1120-1(1966).

Drifts in the ionosphere were observed at Mirny during the Eighth Antarctic Expedition. The motions of small-scale inhomogeneities were measured by the methbd of closely spaced reception. The arrangement of the receiving antennas is shown. Histograms of the drift speed and direction are shown, and results of a harmonic analysis of the annual drift data for each layer of the ionosphere are presented. Consideration is given to the dependence of drift speed on magnetic activity. (J.H.M.)

39928 VERTICAL DRIFT OF SMALL-SCALE INHOMOGENEITIES OF IONOSPHERIC IONIZATION. Drobzhev, V. I. (Ionosphere Section, Academy of Sciences, Alma-Ata, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 878-9(1966).

Translated from Geomagn. Aeronomiya, 6: 1122-3(1966).

A method for determining the direction of vertical drift of small-scale inhomogeneities in the ionosphere is discussed. A typical example is presented of the records analyzed (January 18, 1966, t = 16 h 32 m, f = 3.6 MHz, Δf = 13 kHz, h = 240 km), and the results of an analysis are included. (J.H.M.)

39929 QUIET SOLAR-DIURNAL MAGNETIC VARIATIONS AT ALMA-ATA IN 1964, THEIR DAY-TO-DAY VARIABILITY, AND RELATION TO THE STATE OF THE IONOSPHERE. Rudneva, N. M. (Ionospheric Section, Academy of Sciences, Alma-Ata, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 880-1(1966).

Translated from Geomagn. Aeronomiya, 6: 1124-5(1966).

The study is concerned with the variability of S_q variations in 1964 and its comparison with the state of the ionosphere. To study the patterns of the variability of S_q variations, the diurnal patterns of the X and Y components of the magnetic field were computed as deviations from the night level for all International Quiet Days in summer and during the equinox. To describe quantitatively the day-to-day variability of S_q variations, the mean hourly deviations of the individual diurnal patterns of ΔX and ΔY from the average seasonal diurnal pattern were computed. The average seasonal behavior of ΔX and ΔY throughout a day for positive and negative ΔX and ΔY is shown. Data indicate that there is good agreement between the computed diurnal variations of the X component of the magnetic field and the variations obtained experimentally. An attempt was made to establish a relationship between the variability of S_q variations and the appearance of the E_s-layer. (J.H.M.)

39930 IONOSPHERIC CURRENT SYSTEM OF THE INITIAL PHASE OF THE GEOMAGNETIC STORM OF SEPTEMBER 4, 1957. Antsilevich, M. G.; Sofienko, L. A. (Inst. of Nuclear Physics, Tashkent). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 882-3(1966).

Translated from Geomagn. Aeronomiya, 6: 1126-7(1966).

Observations were made from 39 magnetic observatories of the magnetic storm of September 4, 1957. The data were used to construct an approximate equivalent current system in the ionosphere The results indicate that a current jet flowing in the ionosphere above the polar cap during weak geomagnetic disturbances and the averaged current jet for strong disturbances depend little on the type and stage of a geomagnetic storm. (J.H.M.)

39931 INTENSITY AND SPECTRUM OF HYDROMAGNETIC EMISSION IN THE 1 HZ RANGE. Gul'el'mi, A. V. (Inst. of Terrestrial Physics and the Atmosphere, Ashkhabad, USSR). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 884-6(1966).

Translated from Geomagn. Aeronomiya, 6: 1129-30(1966).

The properties of narrow-bond hydromagnetic emission in the 1 Hz range (pearls) are discussed. (auth)

39932 NIGHTTIME PLASMA TRANSPORT IN THE TOPSIDE IONOSPHERE USING BACKSCATTER N-h PROFILES. Rao, P. B. (Cornell Univ., Arecibo, Puerto Rico). 24p. (CONF-670429-9). DTIE.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

Vertical transport velocities of the electrons in the topside ionosphere are calculated from the continuity equation for the nighttime F region by using the electron density profiles obtained from incoherent backscatter measurements at Arecibo (18.4°N. 67°W). The electron transport for the height range 400 to 700 km is found to be predominantly downwards with the largest values of the velocity and its height gradient observed during the early part of the night when the plasma temperature is shown to be falling at a rate of about 3.5°K per minute. An electron flux of magnitude greater than 10^{12} m^{-2} sec^{-1} obtained for the height of 700 km is associated with the diffusive transport following the rapid cooling of the exospheric plasma. Later in the night, when the plasma temperature changes are not appreciable, an electron flux of magnitude less than 3×10^{11} m^{-2} sec^{-1} is shown to result from the transport of possible electrodynamic origin. The postmidnight increase observed in the F^2 layer peak electron density is found to depend strongly on the magnitude of the topside transport velocity. (auth)

39933 ROCKET MEASUREMENTS OF LOW ENERGY ELECTRONS IN ACTIVE AURORAS. Ulwick, J. C.; Sandock, J. A. (Air Force Cambridge Research Labs., Bedford, Mass.). 17p. (CONF-670429-10). DTIE.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

Retarding potential analyzers (RPA) were flown along with other experiments on two Aerobee rockets at Churchill, Canada, into a diffuse type of aurora of IBC 1 and into rapidly moving discrete forms of IBC 2. The electron detectors on both rockets, in addition to measuring electron density and temperature, measured hyperthermal electrons to energies of 5 eV. One rocket had an RPA for the measurement of electron energies in the range 0 to 540 eV. The secondary current measured with the positive ion detector was found to have an almost one-to-one correlation with the high-energy electrons. The measurements for each individual rocket compare remarkably well in structure, but the energies measured in the active aurora showed a large degree of variation or structure compared with the results of the diffuse aurora. The electron temperatures measured show a remarkable correlation with the electron flux above 75 eV or the equivalent secondary flux from the ion detector. (auth)

39934 INTERPRETATION OF ROCKET MEASUREMENTS IN A VISIBLE AURORA. Pfister, W. (Air Force Cambridge Research Labs., Bedford, Mass.); Baker, K. D. 16p. (CONF-670429-6). DTIE.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

Experimental data on a wide range of physical parameters were gathered about the breakup phase of an aurora during several Aerobee rocket flights at Ft. Churchill, Canada. A comparison of different types of simultaneous measurements facilitates an interesting interpretation of the data. The results are discussed in three particular areas: ion production rate, electron temperature, and electrostatic fields. The ion production rate can be derived in five different ways, from the incident spectrum, from the local spectrum, from the local integrated flux of electrons above 75 eV, from the secondary current emitted off a tungsten cathode, and from photometer data. The measured electron temperature is compared with a computed value based on the ion production rate and the electron density. Evidence is presented for the existence of a local electrostatic field of the order of volt/m. (auth)

39935 ROCKET-BORNE MEASUREMENTS OF AURORAL LIGHT AND ASSOCIATED ELECTRON DENSITIES. Baker,

K. D. (Univ. of Utah, Salt Like City); Haycock, O. C.; Ulwick, J. C. 12p. (CONF-670429-8). DTIE.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

In situ measurements of auroral light and electron densities of the auroral E region were conducted aboard two Aerobee rockets (AD 3.612, AE 3.613) flown into visual auroral forms from Churchill, Canada, during March 1965. These flights probed auroral regions of low to medium intensity during the breakup phase. (auth)

39936 A 10 cps PERIODICITY IN THE PRECIPITATION OF AURORAL ZONE ELECTRONS. Evans, David S. (Goddard Space Flight Center, Greenbelt, Md.). 31p. (CONF-670429-11; X-611-67-216). DTIE.

From 48th Annual Metting of American Geophysical Union, Washington, D. C.

An observation was made, using rocket borne radiation detectors, of a purely temporal 10 cps periodicity in the flux of auroral electrons in the energy range 1 to 120 keV. The periodicity was biased toward the higher energy electrons in the sense that it was these that underwent the greatest relative fluctuation. A cross correlation analysis revealed that there was no significant displacement in time between peaks at 16 and 120 keV thereby localizing the mechanism causing the modulation to within about 1000 km of the Earth. At the same time that this periodicity was observed a determination of the electron energy spectrum showed that a strong monoenergetic electron component ($E \approx 6$ keV) was present in the influx. A process in analogy with that process which produces runaway electrons in laboratory plasmas is proposed to account for both the presence of 100-keV electrons in the beam and the appearance of 10 cps periodicity in their flux. The beam of 6-keV electrons as it entered the increased electron density of the upper F layer may have excited a variety of plasma oscillations. Conditions may have been proper for one of these waves to grow in amplitude. A resonance between the frequency of this wave and the gyrofrequency of the 6-keV electrons could then lead to the rapid acceleration of certain favored electrons to very high energy. The time constant of the excitation, growth and subsequent damping of this wave is then reflected in the low-frequency periodicity observed in these accelerated electrons. (auth)

39937 DYNAMICS OF THE MAGNETOSPHERIC SHOCK: SOLAR BLAST WAVE INTERACTION. Dryer, Murray (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). 25p. (CONF-670711-1). DTIE.

From 8th International Space Science Symposium, London.

The macroscopic fluid model is used to provide insight into the time-dependent behavior of the dynamic interaction between a solar flare-generated blast wave and Earth's standing magnetospheric shock wave. Theoretical and laboratory experiments are described within the context of ordinary gasdynamics. The pressure rise, for example, at the subsolar point can increase by an order of magnitude during a 1-min time scale. This experience is then directed to the interpretation of some satellite-observed events that may have been due either to filamentary sectors separated by tangential discontinuities or to the extreme case of the propagating blast wave under consideration. The latter phenomenon may have been associated with the March 12, 1965, magnetic storm, which was preceded by a sudden commencement. Events associated with the magnetic storm of August 18, 1965, as observed by Vela 3A and Imp 3 are tentatively described as a consequence of the former phenomenon. (auth)

39938 MAGNETOSPHERIC TAIL AS A HYDROMAGNETIC WAVEGUIDE. Patel, V. L. (Univ. of Denver). 11p. (CONF-670429-15). DTIE.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

The magnetospheric tail region is approximated to an idealized cylindrical hydromagnetic waveguide of 7 earth radii. With the assumptions that this waveguide contains a uniform magnetic field B = 10 gammas, and a uniform plasma of density $\lesssim 1$ proton per cm^3, cutoff periods of hydromagnetic waves are calculated. It is shown that the transverse (T) hydromagnetic wave has a fundamental period of ~200 sec, and the mixed transverse and longitudinal magnetohydrodynamic (TLM) wave has two approximate fundamental periods of 20 and 30 min for two different boundary conditions. These fundamental periods have been discussed with the recent observations by satellite experiments (auth)

39939 STUDIES OF THE AURORAL SUBSTORM. III. CONCEPT OF THE MAGNETOSPHERIC SUBSTORM AND ITS RELATION TO ELECTRON PRECIPITATION AND MICROPULSATIONS. Coroniti, F. V.; McPherron, R. L.; Parks, G. K. (Univ. of California, Berkeley). 26p. (CONF-670429-16). DTIE.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

The concept of the auroral substorm is reviewed in terms of recent satellite measurements of the magnetospheric effects of a substorm, and a more general and inclusive terminology, the magnetospheric substorm, is suggested. In support of this suggestion it is shown that the various forms of geomagnetic micropulsations and energetic electron precipitation occur at their respective local times during a substorm. Balloon x-ray and micropulsation data obtained by the Berkeley group as well as riometer absorption, earth currents and standard magnetograms from several auroral zone stations have been used. (auth)

39940 STUDIES OF THE AURORAL SUBSTORM. II. CORRELATED MAGNETIC MICROPULSATIONS AND ELECTRON PRECIPITATION OCCURRING DURING AURORAL SUBSTORMS. McPherron, R. L.; Parks, G. K.; Coroniti, F. V.; Ward, S. H. (Univ. of California, Berkeley). 35p. (CONF-670429-17). DTIE.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

The temporal characteristics of geomagnetic micropulsations and the associated energetic auroral zone electron precipitation are presented as a function of local time. In the midnight region broad band noise bursts and impulsive electron precipitation are related to the auroral breakup. Band limited irregular (Pi 1) micropulsations and modulated electron precipitation of 5 to 10 second period occur from 0200 to 1000 in conjunction with negative bays. In the local time interval 1000 to 1500 quasi-sinusoidal (Pc 3) micropulsations are related to modulated electron precipitation of 20 to 40 second period. Power spectrum and digital sonagram analysis for the band limited irregular and quasi-sinusoidal micropulsations and the modulated electron precipitation are presented. Around local noon, magnetic impulses are correlated with electron microbursts. From 1500 to 2200 sweepers or I.D.P.D. events and pre-midnight micropulsations show no relation to electron precipitation, but are closely related to auroral substorms. Pearl pulsations appear to have no definite association with either electron precipitation or substorms. (auth)

39941 STUDIES OF THE AURORAL SUBSTORM. I. CHARACTERISTICS OF MODULATED ENERGETIC ELECTRON PRECIPITATION OCCURRING DURING AURORAL SUBSTORMS. Parks, G. K.; Coroniti, F. V.; McPherron, R. L.; Anderson, K. A. (Univ. of California, Berkeley). 34p. (CONF-670429-18). DTIE.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

The temporal, energy and spatial characteristics of energetic auroral zone electron precipitation in the 5- to 35-second period range are discussed. The electron pulsations of 5- to 10-second period occur during 0200 to 1000 local time, have a soft energy spectrum with an e-folding energy of about 15 keV, and show spectrum hardening at the peaks. The region over which the electron pulsations are occurring is about 100 to 150 km. The electron pulsations of 20 to 35 second period occur during 1000 to 1500 local time, possess a hard energy spectrum with an e-folding energy of about 30 keV and occasionally show spectral hardening at the peaks. The scale size of these electron pulsations is often 100 to 150 km, but occasionally is greater than 210 km. The electron pulsations and the other forms of energetic electron precipitation that occur in the auroral zone are direct consequences of worldwide disturbance characteristics of auroral substorms. (auth)

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Refer also to abstract 40719.

39942 (IS-T-169) FIELD MODULATION STUDIES OF THE DE HAAS-VAN ALPHEN EFFECT IN NICKEL. Stone, Dennis Ray (Ames Lab., Iowa). May 1967. Contract W-7405-eng-82. 98p. Dep. CFSTI.

Thesis.

The de Haas–van Alphen effect was studied in spherical nickel crystals in fields up to 63 kOe and at temperatures as low as 1.1°K using a low frequency (~40 Hz) field modulation technique. These measurements showed that the field modulation technique could be used for ferromagnetic samples provided that the modulation frequency was less than 25 kHz and that the modulation field was parallel to the applied field direction. The observed de Haas–van Alphen oscillations are interpreted as arising from two distinct sheets of Fermi surface—one, a multiply connected copper-like sheet centered at the point Γ in the zone and, the other, a set

of equivalent fluted ellipsoids situated at the symmetry points X in the zone. These surfaces were interpreted in terms of the band structure predicted by L. Hodges and it has been shown that these measurements are in complete accord with these new calculations. (auth)

39943 (MIT-3700-5) MACROVORTICES AND TRANSIENT STABILITY IN HARD SUPERCONDUCTORS. Iwasa, Y.; Williams, J. E. C. (Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.). Aug. 22, 1967. Contract AT(30-1)-3700. 15p. (CONF-670801-5). Dep. CFSTI.

From Cryogenic Engineering Conference, Palo Alto, Calif.

It has been found previously that under certain conditions and in the absence of transport current, a state of uniform magnetization in a hard superconducting wire can be caused to change to a spatially periodic magnetization. During this change, the magnetization at discrete equally-spaced points along the wire collapses sequentially, generating a sequence of voltage pulses in any circuit inductively coupled with the wire. These effects are investigated using a short length of superconducting wire mounted in the end face of a phenolic tube. A pulse coil is located close to one point on the wire and a magneto-resistance probe is mounted on a rotating plate close to the surface of the wire. This entire assembly is placed in a magnetic field of about 10 to 20 kG to magnetize the wire. (M.H.R.)

39944 (UCRL-17353) IMPORTANCE OF HEAT TRANSFER IN THE STABILIZATION OF SUPERCONDUCTORS. Green, Michael A. (California Univ., Berkeley. Lawrence Radiation Lab.). June 14, 1967. Contract W-7405-eng-48. 10p. (CONF-670705-11). Dep. CFSTI.

From 2nd International Conference on Magnet Technology, Oxford, England.

In 1965 Z. J. J. Stekly and J. L. Zar demonstrated that superconducting coils could be stabilized by the use of a substrate. The key to this stabilization technique is a local heat balance between heat generated in the substrate when the superconductor goes normal and heat removed. The current density within a superconductor is a function of local magnetic field and local temperature. The local temperature is a function of heat transfer to the helium when the superconductor goes normal. The heat transfer from the superconductor to the fluid boundary is analyzed. The validity of basic assumptions often made while designing a stabilized system is discussed. The convective heat transfer to the liquid helium is analyzed. Included in this analysis is a discussion of single-phase pressurized helium cooling. One important consideration that is often ignored by the designer of stabilized magnets is that a magnet may be stabilized when an additional heat load is being produced in the superconductor substrate combination. The external source of heat may be from interaction with an accelerated beam, natural radioactive decay, eddy currents generated by changing fields, or hysteresis-type losses. The additional heat loads must be removed from the superconductor substrate combination in order for stable superconducting operation to be maintained. Several methods for improving the heat transfer from the superconductor to the helium are discussed. The development of ac magnets and improvements in substrate current density for large high-field dc magnets can result from substantial improvements in the heat transfer. (auth)

39945 THE BCS THEORY AND THE POSSIBILITY OF ACHIEVING SUPERCONDUCTIVITY AT ROOM TEMPERATURE. Bankuti, Jozsef; Kirschner, Istvan; Kovacs, Istvan (Lorand Eotvos Univ., Budapest). Fiz. Szemle, 17: 236-41(Aug. 1967). (In Hungarian).

The early theories of superconductivity were unable to explain subsequent experimental results. Following the discovery of the isotopic effect, Bardeen, Cooper, and Schrieffer developed a microscopic model based on the quantum theory which yielded results in agreement with experimental data. They assumed that the energy difference between the superconducting and normal phases is due to interaction arising from the virtual phonon transfer between electrons and the Coulomb interaction. Superconductivity would be of great interest for many processes but the required low temperature makes its application uneconomical. On the basis of the BCS theory it is possible to estimate the possibility that superconducting phenomena may occur at room temperature. The "molecular" superconductivity arises when charge carriers possess close impulse states, resulting in interaction between electrons and thus making pair formation possible. The transition temperature at such superconductivity may be estimated from theoretical data. Such considerations directed attention to the surface superconductivity. The attractive interaction may be enhanced by the introduction of impurity atoms. It might be also possible to use semiconductors; GeTe and $SrTiO_3$ were studied in this respect but no satisfactory experimental results were obtained. (TTT)

39946 HELICON RESONANCES IN NIOBIUM NEAR H_{c2}. Maxfield, B. W. (Cornell Univ., Ithaca, N. Y.). Contract AT-(30-1)-2150. Phys. Rev. Lett., 19: 569-70(Sept. 4, 1967). (NYO-2150-31).

An experiment was conducted to determine the field dependence of the helicon resonant frequency near H_{c2} in a pure, strain-free sample of niobium having a residual-resistance ratio of about 11,000. The results are plotted and show that the field dependence near H_{c2} is different from that reported previously by Maxfield and Johnson, probably because strains that were introduced by spark cutting are no longer present. (J.H.M.)

39947 IMPOSSIBILITY OF BOSE CONDENSATION OR SUPERCONDUCTIVITY IN PARTIALLY FINITE GEOMETRIES. Krueger, David A. (Univ. of Washington, Seattle). Phys. Rev. Lett., 19: 563-5(Sept. 4, 1967). (RLO-1388-517).

The vanishing of the quasi averages usually associated with superfluidity and superconductivity is shown for arbitrarily interacting Bose and Fermi systems which are confined to a geometry with one or more dimensions finite while one or more dimensions extend to infinity. However, it is suggested that these partially finite geometries are anomalous and are not good approximations to thin film and pore geometries found in the laboratory. The conditions on the box size which are necessary and sufficient for condensation to occur in an ideal Bose gas are also given. (auth)

39948 INTRINSIC CRITICAL VELOCITY OF A SUPERFLUID. Langer, J. S.; Fisher, Michael E. (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 19: 560-3(Sept. 4, 1967).

A fluctuation theory of the intrinsic critical velocity of a superfluid near the lambda point is developed in analogy with the droplet model of condensation of a supersaturated vapor. For the superfluid, vortex rings play the role of critical droplets in homogeneously nucleating transitions to states of lower superflow. A quantitative estimate is in reasonable agreement with recent experiments on helium. (auth)

39949 DIRECT EVIDENCE FOR THE LAMINAR AND FLUX LINE MODELS OF MIXED STATE IN TYPE-II SUPERCONDUCTORS. Sarma, N. V. (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). Phys. Lett., 25A: 315-16(Aug. 28, 1967).

A direct observation of the mixed state in a Pb-2 at. % In specimen indicates the existence of both a laminar structure and a triangular flux line lattice structure. (auth)

39950 SPIN DIFFUSION IN SOLID ^{3}He. Thompson, J. R.; Hunt, E. R.; Meyer, H. (Duke Univ., Durham, N. C.). Phys. Lett., 25A: 313-14(Aug. 28, 1967).

A systematic study of the spin diffusion constant D in solid bcc ^{3}He at temperatures below 0.8°K is reported. It is shown that the measured D, which is temperature-independent, is proportional to the exchange parameter J, defined from the isotropic Hamiltonian $\mathcal{H} = -hJ\mathbf{I}_1 \cdot \mathbf{I}_2$. (auth)

39951 MAGNETIC IMPURITIES AND SUPERCONDUCTIVITY BELOW THE KONDO TEMPERATURE. Celli, V.; Zuckermann, M. J. (Univ. of Virginia, Charlottesville). Contract AFOSR-1138-66. Phys. Lett., 25A: 305-6(Aug. 28, 1967).

A Green function treatment is used to find an expression for the superconducting critical temperature T_c for dilute magnetic alloys in the limit $T_c \ll T_K$, where T_K is the Kondo temperature. (auth)

39952 ENTROPY AND SPECIFIC HEAT OF A SUPERCONDUCTOR IN THE MIXED STATE. Milleron, P. F.; Fournet, G. (LCIE, Fontenay-aux-Roses, France. Faculte des Sciences, Paris). Phys. Lett., 25A: 304-5(Aug. 28, 1967).

The entropy and specific heat are obtained from a cellular model of a vortex. The inferences of various assumptions are studied. (auth)

39953 SUPERCONDUCTING TRANSITION TEMPERATURE OF INDIUM IN POROUS GLASS. Watson, J. H. P. (Corning Glass Works, N. Y.). Phys. Lett., 25A: 326-7(Aug. 28, 1967).

Measurements are presented of the superconducting transition temperature of indium in porous glass. The hydroxyl groups on the glass surface were replaced with Cl^- and CH_3O^- before impregnation with indium; this treatment altered the dielectric constant and the transition temperature. (auth)

39954 APPROACH TO MAGNETIC SATURATION IN SINGLE-CRYSTAL THULIUM AT 4.2°K AND 140 kG. Foner, S.; Schieber, M.; McNiff, E. J. Jr. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., 25A: 321-2(Aug. 28, 1967).

Magnetic moment measurements along the [10$\bar{1}$0] direction in single crystal Tm at 4.2°K are presented for fields up to 140 kG. A value of σ of about 220 emu/gm, by far the highest reported for Tm, is obtained at 140 kG and is close to the value expected

for $Tm^{3+}(7\mu_B)$. The data indicate that the saturation value of σ is even higher. Lack of single crystals and high fields as well as the high-anisotropy energy of Tm all conspired to limit previous measurements and their interpretation. (auth)

39955 INFLUENCE OF A CONTINUOUS ALTERNATING CURRENT (50 Hz) ON THE CRITICAL FIELD OF LEAD FILMS AT 4.2°K. Maldy, J.; Santamaria, E.; Donadieu, L. (Centre de Recherches de la Compagnie Generale d'Electricite, Marcoussis, France). Phys. Lett., 25A: 318-19(Aug. 28, 1967). (In French).

In a perpendicular magnetic field larger than 0.3 H_{c2}, the critical current of a thin lead film fits the empirical expression $I_c \propto (H_{c2}-H)^{\frac{1}{2}}$. In ac current the transition appears when the peak current reaches the critical dc value. (auth)

39956 OFF-DIAGONAL LONG-RANGE ORDER IN THE BCS THEORY. Rensink, Marvin E. (Univ. of California, Los Angeles). Ann. Phys. (N.Y.), 44: 105-11(Aug. 1967).

The two-particle reduced density matrix ρ_2 is analyzed for a system of electrons described by the BCS ground state. The existence of off-diagonal long-range order in ρ_2 is demonstrated by explicit calculations of its matrix elements. It is shown that ρ_2 has one eigenvalue proportional to N where N is the number of electrons in the system. This eigenvalue is, in fact, equal to the number of dynamically correlated electrons. The large eigenvalue is produced by those pair states in momentum space for which the occupation probability is neither zero nor one. The correlation function for electrons with opposite spin is shown to be just the absolute square of the eigenfunction associated with the large eigenvalue of ρ_2. (auth)

39957 DIP EFFECT IN THE HALL ANGLE OF A TYPE-II SUPERCONDUCTOR. Baixeras, J. (LCIE, Fontenay-aux-Roses, France); Williamson, S. J. Solid State Commun., 5: 599-602 (Aug. 1967).

Measurements of the magnetic field dependence of voltages arising from vortex motion in a cold-rolled ribbon of Nb–1% Zr displayed a dip in the voltage longitudinal to the impressed electric current accompanied by a more pronounced dip in the Hall voltage. The direction of vortex motion in two dimensions as a function of applied field, as deduced from the observed voltages, was in qualitative agreement with existing theories of vortex pinning. (auth) (UK)

39958 METASTABLE STATES OF THE SUPERCONDUCTING SURFACE SHEATH IN DECREASING FIELDS. Park, J. G. (Imperial Coll. of Science and Tech., London). Solid State Commun., 5: 645-8(Aug. 1967).

The limiting field H_s below which there are no surface sheath solutions of the one-dimensional Ginzburg–Landau equation is calculated as a function of κ. When $\kappa > \kappa_d$, where $\kappa_d \geq 0.595$, there is probably a second order transition to the Meissner state at H_c rather than a first order transition at the supercooling field H_s. When $\kappa \leq 0.406$, $H_s = H_{c3}$, the effects on these transition fields of currents induced in the surface sheath are discussed. (auth) (UK)

39959 A SUPERCONDUCTIVE MAGNET MADE FROM AN Nb-Zr ALLOY WITH A FLUX DENSITY OF 85 kG. Goncharov, I. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 2, 236-9(Mar.-Apr. 1967). (In Russian).

A superconducting magnet consisting of a two-coil superconducting solenoid with a pair of inner pole shoes is described. The solenoid is wound from 0.29-mm Nb–75% Zr alloy wire which is copper plated by drawing it through a copper tube and heat treating it. The inner coil is removable, while the outer coil is divided electrically into two parts which can be switched in parallel or in series. The system is characterized by stability of the critical current value, which remained virtually unchanged with a temperature drop from 4.2 to 1.6°K. The maximum of the critical current was between 4.05 and 3.8°K, with a slight drop (to 42 to 43 amp at 2.5°K) thereafter. Training effects (i.e., an increase in the critical current in subsequent tests) were absent. The results of testing the alloy confirmed its high stability and effectiveness. The alloy is recommended for use in the construction of large-size solenoids, where its relatively low cost, high level of critical current, and high plasticity (which facilitates the plating process) present considerable advantages. Ferromagnetic core inserts bring the flux density in a 1.1-mm gap to 85 kG. (ATD)

39960 TRANSITION OF TYPE-I SUPERCONDUCTING THIN FILMS IN A PERPENDICULAR MAGNETIC FIELD: A MICROWAVE STUDY. Gittleman, Jonathan I. (RCA Labs., Princeton, N. J.); Bozowski, S.; Rosenblum, Bruce. Phys. Rev., 161: 398-403(Sept. 10, 1967).

Microwave resistance measurements undertaken to seek direct evidence for the existence of the mixed state in thin type-I films are described. The measurements were for the most part confined to indium films. The observed change in the microwave resistance of the films as a function of magnetic field applied perpendicular to the surface is, in detail, similar to reported surface resistance measurements on bulk type-II superconductors. This includes the intrinsic hysteresis observed below H_{c3} and the existence of a superconducting surface layer at the edge of the film that persists to H_{c3}. (auth)

39961 MAGNETIC INSTABILITIES IN TYPE-II SUPERCONDUCTORS. Wipf, S. L. (Atomics International Inc., Canoga Park, Calif.). Phys. Rev., 161: 404-16(Sept. 10, 1967).

The stability of the equilibrium between flux pinning and Lorentz forces acting on the flux structure in the mixed state is investigated. Complete stability is expected only if the temperature gradient of the flux pinning forces, $\partial F_p/\partial T$, is positive; otherwise the stability is affected by external field and geometry considerations. For the simple case of a semi-infinite slab, cooled in zero field, a calculation is given using standard empirical formulas for $F_p(B,T)$; the field above which instability is found then becomes $H_{fi} = \frac{1}{2}\pi^{\frac{1}{2}}[c(T_c^2 - T^2)/T]^{\frac{1}{2}}$, where c is the specific heat per unit volume and T_c the critical temperature. For $H_{fi} < H < H_{fj}$, the flux lines are accelerated by the Lorentz force until thermal recovery restores F_p. This is called a limited instability. Above H_{fj}, the acceleration becomes too large compared to the thermal recovery and a runaway speed is reached. This runaway instability is identified with flux jumping. A simplified approach to the heat equation allows an estimate to be made of the maximum speed during a limited instability and of the flux-jumping field H_{fj}, if the thermal diffusivity is known. The applicability of the given calculations and the influence of various parameters are discussed, as well as some pertinent experimental results. (auth)

39962 LOW-FREQUENCY PERMEABILITIES OF A SUPERCONDUCTOR DUE TO SURFACE CURRENTS. Fink, H. J. (Atomics International Inc., Canoga Park, Calif.). Contract AT(11-1)-GEN-8. Phys. Rev., 161: 417-22(Sept. 10, 1967).

Superconductors that can carry critical persistent currents around the circumference of a specimen may dissipate energy when an alternating magnetic field $h_0 \cos \omega t$ is superimposed on a magnetic field H_0 swept at a constant rate dH_0/dt. For a long macroscopic superconducting cylinder, the real and imaginary parts of the permeabilities due to the surface currents alone are calculated for the first three Fourier components of the internal field. The results are complicated and depend on two parameters, namely, $(dH_0/dt)/\omega h_0$ and $h_c(H_0)/h_0$. The function $h_c(H_0)$ is a measure of the current-carrying capacity of the surface of the superconductor. (auth)

39963 MAGNETIC PROPERTIES OF SOME TYPE-II ALLOY SUPERCONDUCTORS NEAR THE UPPER CRITICAL FIELD. Fietz, W. A.; Webb, W. W. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 161: 423-33(Sept. 10, 1967).

Parameters pertinent to the magnetic properties of type-II superconductors near the upper critical field H_{c2} [namely, the generalized Ginzburg–Landau parameters κ_1 and κ_2, and the functions $h^* = H_{c2}/(-dH_{c2}/dt)_{T_c}$] have been obtained from magnetization measurements on a series of niobium–titanium alloys. The range of electron-transport mean free paths, from 0.1 ξ_0 to about 15 ξ_0 (where ξ_0 is the coherence length in pure Nb), effectively spans the range from the clean to the dirty limit, with annealed and cold-worked specimens at temperatures between 0.13 T_c and T_c. It was found that both κ_1 and κ_2 increased with decreasing temperature in all alloys and that the magnitude of the increase was 20 to 50% higher than expected from existing theory. The experimental value of the parameter $H_{c2}/(dH_{c2}/dt)$ at $T = T_c$ varies with impurity roughly as expected in Ginzburg–Landau theory. Defects generated by cold work enhanced the increase of κ_1 at low temperatures. (auth)

39964 SUPERCONDUCTIVITY AND ELECTROMAGNETIC POTENTIAL. Rothen, F.; Rivier, D. (Univ., Lausanne, Switzerland). Helv. Phys. Acta, 40: 571-95(1967). (In French).

A discussion is given on the various connections existing between the phenomenology of superconductivity and the so-called observability of the electromagnetic potentials. The starting point is a classical model, essentially due to F. London, for the flow of the superconducting electrons: a relativistic fluid, charged, incompressible, and nonviscous. The quantum version of this model presents a striking property, namely the quantization of a certain quantity, the generalized fluxoid, of which two main aspects are the well-known London fluxoid on one side and the periodic differential action on the other side. The quantization of this last quantity, closely connected with the existence of a periodicity for the Josephson currents, suggests a new effect involving the scalar potential. Finally, the main implications of the electro-

dynamics with nonvanishing photon mass on the phenomenology of superconductivity are established. (auth)

39965 ANGULAR MOMENTUM OF SUPERFLUID HELIUM IN A ROTATING CYLINDER. Hess, G. B. (Stanford Univ., Calif.). Phys. Rev., 161: 189-93(Sept. 5, 1967).

The angular momenta of low-energy states of superfluid helium in a circular cylinder rotating about its axis are calculated on the basis of the Onsager–Feynman vortex model. The ranges of angular velocity, in which n = 0, 1, 2, ..., 7 vortices successively give the lowest-energy state, are determined. The angular velocity range in which an n-vortex state may be metastable is also considered. Finally, the relaxation time due to interaction of the normal fluid with a vortex state that is not metastable is computed, following a similar calculation by Hall and Vinen. (auth)

39966 PROPERTIES OF DILUTE MIXTURES OF ^{3}He IN LIQUID ^{4}He AT LOW TEMPERATURES. Emery, V. J. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Phys. Rev., 161: 194-201(Sept. 5, 1967). (BNL-11211).

Properties of dilute mixtures of ^{3}He in liquid ^{4}He are calculated on the assumption that, for the most part, they behave as low-density fermion systems with an effective ^{3}He Hamiltonian. Expressions for ^{3}He scattering amplitudes in terms of phase shifts are obtained, and the measured spin diffusion coefficient D for temperature T below 1°K is used to determine the effective interaction between ^{3}He atoms. It is found to have a strong repulsive region with a longer-range attraction that is deeper but of shorter range than the corresponding part of the Van der Waals force. At low momenta, the phase shifts are small, and at low temperatures, the effects are weak. At higher temperatures, larger momenta are probed, and the scattering is more significant. The phase-separation curve and the low-temperature viscosity, thermal conductivity, spin susceptibility, compressibility, and specific heat are calculated and agree with existing experimental evidence. It is found that the mixtures should undergo a fermion superfluid phase transition, but the maximum transition temperature is 10^{-6}°K. Evidence for the transition should be found in a 4% decrease of DT^2 between 10^{-2}° and 2×10^{-3}°K. (auth)

39967 PRODUCTION AND DETECTION OF SOLITARY MACROSCOPIC QUANTIZED VORTICES IN HELIUM II. Finch, R. D.; Chu, M. L. Jr. (Univ. of Houston, Tex.). Phys. Rev., 161: 202-(Sept. 5, 1967).

Ultrasonic cavitation was induced in liquid helium using plane and cylindrical standing-wave systems resonant at 89 and 53 kc/sec, respectively. The threshold voltage for cavitation noise was measured at different rotation rates of a shaft, with and without an attached paddle, rotating in the vicinity of the sound field. Below the λ point the threshold was found to be lowered sharply at a critical rotation rate ω_c. The experiments were repeated with five different shaft sizes, and ω_c was found to be inversely proportional to r^2, where r is the radius of the shaft. The constant of proportionality was found to be $\hbar/m$, where m is the mass of one helium atom. Further, smaller threshold reductions were observed at rotation rates of $2\omega_c$, with the largest shaft sizes. These results are consistent with the theory of quantized vortex formation and appear to indicate that such vortices play a role in the cavitation nucleation process. (auth)

39968 RADIATION OF SOUND IN He-II FILMS. Pollack, Gerald L. (Michigan State Univ., East Lansing). Phys. Rev., 161: 172-8(Sept. 5, 1967).

Locally disturbed static He-II films are investigated with the two-fluid model. It is assumed that motion of the normal fluid is retarded by a viscous force per unit volume $r\omega\rho v_n$, in which r is a dimensionless viscosity parameter whose value in He-II films is shown to be $10^2 \leq r \leq 10^4$. A general surface wave and thermal disturbance is propagated through the film by two wave modes: a third-sound wave and a new highly attenuated wave; these are first redescribed. For arbitrary initial conditions, the amounts of each mode produced are derived for a general experimental case. In particular, conditions that will produce third sound alone and the new mode alone are derived as functions of temperature and r. It is shown that pure third sound is difficult to produce, since the requirements on phase between the surface wave and temperature excitations are not experimentally natural ones. It is shown that, when the film is locally disturbed with a pure thermal excitation varying as exp iωt, both modes are excited equally and are 180° out of phase, so that the net surface is undisturbed. When the film is locally disturbed with an isothermal pure pressure excitation, then for large viscous force on the normal fluid, almost all of the displacement is in the new mode. The motions of the film variables characteristic of each of the modes are analytically obtained in general, and described quantitatively for a particular case. In the new mode, the normal fluid and superfluid move with almost the same phases and velocities, and are 180° out of phase with the surface wave. In the third-sound mode, the superfluid moves in phase with the surface waves but the normal-fluid motion is more complicated. The results are compared with Lifshitz's results on first and second sound in bulk helium. (auth)

39969 THE DAMPING OF HELICON RESONANCES IN PURE TYPE-II SUPERCONDUCTORS. Maxfield, B. W. (Cornell Univ., Ithaca, N. Y.). Contract AT(30-1)-2150. Solid State Commun., 5: 585-9(Aug. 1967). (NYO-2150-29).

The field dependence of the helicon resonance parameters in the mixed state of pure niobium was measured. The quality factor, Q, of the observed resonance was found to be field-independent in the mixed state and field dependent in the normal state. From this observation a field-independent Hall angle in the mixed state is inferred. (auth) (UK)

39970 SUPERCOOLING OF SUPERCONDUCTORS BELOW THE SURFACE NUCLEATION FIELD. McEvoy, J. P.; Jones, D. P.; Park, J. G. (Imperial Coll. of Science and Technology, London). Solid State Commun., 5: 641-4(Aug. 1967).

Supercooling in fields lower than the surface nucleation field H_{c3} was observed in single crystal samples of lead and tantalum. The experimental results verify the prediction, based on calculations of Feder, and Park, that there are metastable states in which only the surface sheath is superconducting below H_c, when $0.6 > \kappa > 0.41$. Features of the hysteresis in the magnetization curves attributed to superficial currents are discussed. (auth) (UK)

Plasma and Thermonuclear Physics

39971 (TID-23971) QUARTERLY PROGRESS REPORT NO. 86 [ON ELECTRONICS]. Zimmermann, H. J.; Harvey, G. G.; Mason, S. J. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). July 15, 1967. 381p. Dep. CFSTI.

Separate abstracts were prepared for 2 of the included sections. (M.O.W.)

For abstracts of individual sections see: 39714 and 39972.

39972 (TID-23971, pp 123-212) PLASMA DYNAMICS. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Research is described for each of the following areas; (1) interaction of a plasma with an m = 1 rf magnetic field, (2) effects of hydromagnetic turbulence on a weakly ionized argon plasma, (3) time-dependent electron velocity distribution function in an Ar afterglow plasma, (4) Doppler broadening of electron-cyclotron resonance absorption of microwaves, (5) active plasma systems, (6) neutral particle beams with large $\Delta E/E$, (7) MHD wave propagation transverse to electric current density, (8) spontaneous rf emission from hot-electron plasmas, and (9) resonant and nonresonant diffusion in a helically perturbed magnetic field. (M.O.W.)

39973 (P-3564(RAND)) BALL LIGHTNING. Teletov, G. S. Translated by D. Mohr and R. Neiswender from Priroda, 55: No. 9, 84-92(1966). 21p.

The nature of ball lightning is discussed. A review is included of the properties of ball lightning and the hypotheses that have been advanced to explain them. The author's own hypothesis assumes the existence of an unusual state of matter still being studied by modern science. It is noted that one must resort to such hypotheses only when the more customary explanations have been exhausted. (auth)

Confinement and Heating of Plasma

39974 (LA-3713) PROPOSED SCYLLAC COMPUTER SYSTEM FOR DATA ACQUISITION AND TREATMENT. Rawcliffe, A. S.; Ribe, F. L.; Sawyer, G. A. (Los Alamos Scientific Lab., N. Mex.). May 10, 1967. Contract W-7405-eng-36. 18p. Dep. CFSTI.

The Los Alamos θ-pinch program is outlined. The need for a small digital computer for acquiring and reducing experimental data is explained in the context of the Los Alamos Scyllac experiment. (auth)

39975 (SC-DC-67-2040) AN EXPLOSIVE GENERATOR-POWERED Θ-PINCH. Thomson, D. B.; Caird, R. S.; Ewing, K. J.; Fowler, C. M.; Garn, W. B. (Los Alamos Scientific Lab., N. Mex.); Crawford, J. C.; Damerow, R. A. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. Contract AT(29-1)-789. 14p. (CONF-670928-2). Dep. CFSTI.

From Pulsed High-Density Plasmas Conference, Los Alamos, N. Mex.

A recently developed explosively-driven generator has been

used to create neutron-producing plasma in a conventional θ-pinch coil. A spiral-wound, flux-compression device, loaded with 5 lbs of explosive, was used with an exploding-wire high-voltage switch to produce a crowbarred current of 2.6 mA in a 15 nanohenry θ-pinch coil. The rise time was 2.5 μsec, and the peak rate 3 3 mA/μsec. This current produced 114 kG in the θ-pinch coil (25.5 cm long × 6.6 cm ID). Five plasma shots have been fired, each using a 40 kA linear discharge preionizer, a 1.7-kG reverse field, and 85 microns of deuterium in a preconditioned discharge tube. Malfunctions occurred on two shots, and the others produced neutron yields of 2×10^3, 2×10^4, and 5×10^5. The yield rate peaked one μsec before maximum field, with a one μsec half width, suggesting typical short coil losses. The results also show that efficient high-voltage switching is essential to neutron production. Experiments are now in progress to use this switching technique and a 5-mA generator to produce 150 kG in a 35-cm-long coil with similar plasma initial conditions. (auth)

39976 (UCRL-50288) THEORY OF INJECTION OF RELATIVISTIC ELECTRONS INTO THE ASTRON. Woods, C. H. (California Univ., Livermore. Lawrence Radiation Lab.). May 1967. Contract W-7405-eng-48. 33p. Dep. CFSTI.

The process of injecting and trapping relativistic electrons through the effect of an electromagnetic field generated by collective interaction is described in terms of nonoverlapping clouds of particles in μ space. Although the motion of each cloud is characterized by the Vlasov equation, it is shown that repeated injection of particles mixes a characteristic amount of empty space with the particles, and thereby increases the measurable entropy. Some examples of the injection process applicable to the Astron experiment are presented in two-dimensional phase space. (auth)

39977 (UCRL-70519) OBSERVED ANOMALOUS PLASMA LOSS FROM A MINIMUM-B SYSTEM. Coensgen, F. H.; Cummins, W. F.; Ellis, R. E.; Kovar, F. R.; Nexsen, W. E. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 18, 1967. Contract W-7405-eng-48. 8p. (CONF-670928-1). Dep. CFSTI.

From Pulsed High-Density Plasmas Conference, Los Alamos, N. Mex.

Plasma losses from either simple magnetic mirror or minimum-B confinement geometries have been studied in an 18-in.-dia plasma injected system. For conventional vacuum conditions (base pressure ≈5×10^{-7} torr) plasma which is diverted to the wall in forming a minimum-B field introduces an influx of neutral gas which gives rise to plasma losses from impurity generated instabilities as well as atomic processes. By reducing the base pressure to the 10^{-9} torr range and evaporating titanium throughout the entire chamber the neutral influx can be reduced and at least one instability suppressed. Plasma with density up to 5×10^{13} cm^{-3} is formed under conditions where lifetime in a quasi-stationary minimum-B field is not limited by ion–ion scattering, electron cooling, charge-exchange or interchange instabilities. From the presence of high-frequency fluctuations, sporadic end loss and anomalously high attenuation of transmitted microwave beams the plasma is known to be turbulent. In this range from 3×10^{13} to 5×10^{12} cm^{-3} the characteristic decay time lies between 400 and 500 μsec. Below 5×10^{12} cm^{-3} the density decay proceeds in an obviously stepwise fashion indicating intermittent stability. Evidence suggests that the stabilizing effect is also present at higher densities but that the length of the stable periods decreases with increasing density. (auth)

39978 (AD-651089) CONFINEMENT OF PLASMA IN A TRAP WITH A COMBINED MAGNETIC FIELD. Ioffe, M. S.; Sobolev, R. I. Translated from At. Energ. (USSR), 17: 366-75(1964). 21p. (FTD-MT-65-305; TT-67-61679). CFSTI.

The confining properties of an adiabatic trap with a magnetic field increasing in the longitudinal and radial directions are investigated. Such a field is obtained from the combination of a field of the usual mirror configuration (basis field $H_{0||}$) and a field of a system of conductors with current, located in parallel to the axis of the trap (stabilizing field $H_\perp$). The conductors are spaced evenly along the azimuth around the lateral wall. The trap is filled with plasma with density $n \approx 10^9$ to 10^{10} cm^{-3} and proton energy $T_i \approx 5$ keV ($T_e \approx 20$ eV). The dependence of plasma lifetime on the magnitude of $H_\perp$ and the pressure of the neutral gas is measured. On the basis of the results it is concluded that such a field ensures stable confinement of a plasma, not disturbed by magnetohydrodynamic instability (at least for $\beta = (nI/H^2/8\pi) \approx 10^{-4}$). Stabilization is confirmed by analysis of oscillations of the plasma at various values of $H_\perp$. The decay of the plasma is determined by the charge exchange of fast ions on the residual gas; at most the attained times of retention comprise 0.06 sec at $p = 7.10^{-9}$ mm Hg. A qualitative picture of the distribution of the density of the plasma over the radius of the trap is obtained. (auth)

39979 (CLM-Trans-12) CLOSED MAGNETIC CONFIGURATIONS FOR THE CONTAINMENT OF PLASMA. Solovev, L. S.; Shafranov, V. D. Translated by L. C. Ronson (UKAEA, Culham Lab., Abingdon, Eng.), from report IAE-1224. 184p. Dep. CFSTI. UK 24s.

A theoretical investigation was made of magnetic field configurations suitable for containing plasma, and in particular with toroidal configurations in which the magnetic field lines form a set of nested magnetic surfaces. The basic parameters of toroidal configurations determining both the stability of the magnetic surfaces and that of the plasma located in a toroidal trap, are outlined. (auth)

39980 STOCHASTIC MAGNETIC PUMPING. Hall, D. E.; Sturrock, P. A. (Stanford Univ., Calif.). Phys. Fluids, 10: 1593-5(July 1967).

The results of a simple model for betatron-type collisionless statistical heating of particles by random fields are presented, and the relation of this study to other work of this type is discussed. (auth)

39981 TRAJECTORIES OF MAGNETIC FIELD LINES IN TOROIDAL STELLARATORS. Gibson, A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Fluids, 10: 1553-60(July 1967). (CLM-P-129).

Computations are presented to show that in a toroidal $l = 3$ stellarator, in addition to the well-known inward shift of the magnetic axis the following effects occur: the rotational transform on the last closed surface is substantially less than the winding transform; the closed and open surfaces are separated by a complex region; the shape of the surfaces in the central region is essentially as predicted by Aleksin. The maximum shear available in a feasible stellarator is estimated and compared to that required for stability. The effect of perturbations on the perfect toroidal system is computed. (auth)

39982 POSSIBLE STATIONARY MOTION OF A TOROIDAL PLASMA. Bineau, M. (New York Univ.). Phys. Fluids, 10: 1540-4(July 1967).

For a given hydromagnetic equilibrium with nested toroidal magnetic surfaces there is a family of divergenceless vectors V such that $\nabla \times (V \times B) = 0$. This velocity can be interpreted as a mass motion which slightly distorts the equilibrium. (auth)

39983 PARAMETER STUDY OF PLASMA HEATING IN A THETA-PINCH. Bogen, P.; Schlueter, J. (Kernforschungsanlage, Juelich, Ger.). 5p. (CONF-661041-5). DTIE.

From 1st European Conference on Controlled Fusion and Plasma Physics, Munich.

The plasma heating by fast magnetic compression has been studied by many authors. The results of their investigations, however, do not allow to predict accurately the plasma temperature which will be reached in a particular experiment. Temperature measurements were made as a function of charging voltage and initial pressure or line density. The plasma was preheated by an electrodeless ring discharge. No magnetic bias field has been superimposed to the produced initial plasma. (auth)

39984 DIFFUSION PLASMA IN THE EXPERIMENTS DAPHNIS I AND DAPHNIS II. Bernard, M.; Briffod, G.; Gregoire, M.; Weisse, J. (CEN de Saclay, Gif-sur-Yvette, France). 11p. (CONF-661041-13). DTIE.

From 1st European Conference on Controlled Fusion and Plasma Physics, Munich.

Diffusion measurements were made in the central part of the machine. The following results were found: (1) the velocity distribution function of electrons in the B direction monotonically decreases with energy, (2) there is no ionization and recombination in negligible, (3) noise is emitted by the plasma column, and (4) the measured diffusion coefficient is one order of magnitude smaller than Bohm's value but two orders of magnitude greater than the classical value. (M.O.W.)

Diagnostics of Plasma

39985 (SU-IPR-177) RESONANCE RECTIFICATION EFFECTS IN WARM MAGNETOPLASMAS. Crawford, F. W.; Harp, R. S.; Mantei, T. D. (Stanford Univ., Calif. Inst. for Plasma Research). July 1967. 25p. CFSTI.

Study of resonance rectification phenomena in plasmas is extended to the case where a static magnetic field is present. Parallel wire probe geometry has been chosen so that the rf electric field is primarily perpendicular to the magnetic field. Under these conditions, experiments show that there are two distince series of resonance peaks, one occurring between successive cyclotron harmonics, the other precisely at the cyclotron harmonics. Cold plasma theory is inadequate to account for the existence of these

resonances. An explanation is proposed, based on the form of the warm plasma permittivity component perpendicular to the magnetic field, which explains satisfactorily all of the experimental observations. (auth)

39986 (AD-643375) A DYNAMIC THERMOCOUPLE FOR MEASUREMENT OF PLASMA TEMPERATURE TO 400°C. Bzhozovski, V.; Sukerer, Sh.; Endzheets, G. Translated from Paper Presented at Mezhdunar. Simp. Svostvam Primen. Nizkotemp. Plazmy XX-om, Mezhdunar. Kongr. Teor. Prikl. Khim., Moscow, 1965. 15p. (FTD-MT-65-528; CONF-650723-1). CFSTI.

A method is described of measurement of high temperatures of gas (3000 to 4000°C) with the help of a Pt-Pt/10% Rh thermocouple introduced into the investigated region in a pulsed manner. A device is described for dynamic introduction of thermocouple into investigated region together with a time analyzer of the heating curve of the thermocouple. The method is based on measurement of heating of thermocouple in an interval of time smaller than the time necessary for its fusion. There are proposed semiempirical formulas connected according to known measured temperatures of gas in a furnace (less than 1500°C). Basic measurements were conducted in a flow of combustion products obtained in a combustion chamber. (auth)

39987 (AD-653555) EXPERIMENTAL DETERMINATION OF COEFFICIENT OF THERMAL CONDUCTIVITY OF A CESIUM PLASMA. Zarkova, L. P.; Stefanov, B. I. Translated from Paper Presented at Mezhdunar. Simp. Svostvam Primen. Nizkotemp. Plazmy XX-om, Mezhdunar. Kongr. Teor. Prikl. Khim., Moscow, 1965. 14p. (FTD-MT-65-529; CONF-650723-5). CFSTI.

Recently there has arisen an interest in investigating transfer coefficients in the high temperature region above 1500°K. Physical phenomena occurring at high temperatures which strongly influence the coefficient of thermal conductivity deserve special attention. The coefficient of thermal conductivity of cesium vapor in the temperature range of 1600 to 2400°K and the pressure of 15 mm Hg are measured. In the region of 1000 to 1600°K, the results do not depend on pressure, but there is a sharp growth of the coefficient of thermal conductivity observed caused by the ionization heat transfer depending on pressure. This excess "ionization" coefficient of thermal conductivity depends on the coefficient of ambipolar diffusion of ions and electrons and also depends on the degree of ionization (and consequently on pressure). The coefficient of thermal conductivity of argon, neon and mercury vapor in the range of 1100 to 2200°K were measured in the process of mastering the experimental method. (auth)

39988 (AD-653557) APPLICATION OF SPECTROSCOPIC METHODS FOR DIAGNOSTICS OF LOW-TEMPERATURE PLASMA. El'yashevich, M. A.; Grechikhin, L. I.; Kiselevskii, L. I. Translated from Paper Presented at Mezhdunar. Simp. Svostvam Primen. Nizkotemp. Plazmy XX-om, Mezhdunar. Kongr. Teor. Prikl. Khim., Moscow, 1965. 8p. (FTD-MT-65-539; CONF-650723-4). CFSTI.

Methods are given of determining concentrations of charged particles in low-temperature plasma according to measurement of broadening of spectral lines caused by quadratic Stark effect, measurements of intensities of forbidden spectral lines which appear under action of intermolecular electric fields, and intensities of autoionization spectral lines. (auth)

39989 NONLINEAR RESONANCE EFFECT AT HIGH POWER IN A CYLINDRICAL PLASMA. Messiaen, A. M.; Vandenplas, P. E. (Ecole Royale Militaire, Brussels). Phys. Lett., 25A: 339-41(Aug. 28, 1967).

Nonlinear phenomena affect the resonance spectrum of a plasma column excited by an shf field. The luminosity gives a measurement of perturbed plasma density. At high incident energy, the energy absorbed at resonance is sufficient to sustain the plasma in a resonance state. (auth)

39990 METHOD FOR LOCAL MEASUREMENT OF HF MAGNETIC FIELD IN STUDIES OF PLASMA PROPERTIES. Krylov, V. V.; Popyrin, O. I. (Moscow State Univ.). Prib. Tekh. Eksp., No. 2, 147-9(Mar.-Apr. 1967). (In Russian).

A method is described for measuring vhf electromagnetic fields in studies of plasma properties. In this method, the plasma properties are determined by measuring locally the vhf electromagnetic field resulting from mutual interaction of the plasma under study and an applied isophasal, uniform, linearly polarized vhf radiowave beam. Specially constructed miniature tunable dipole antennas with arms 3 mm long and outside cables 0.4 mm in diameter are used as the receiver antennas. The tunable elements ensure maximum antenna sensitivity and polarization properties. Experiments have shown that the antennas can be used for local measurements of plasma properties without introducing distortions; the best results have been obtained by placing the antennas at the plasma channel boundary. (ATD)

39991 ROGOWSKI LOOP FOR MEASURING NANOSECOND DURATION CURRENTS. Stefanovskii, A. M. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 2, 149-52(Mar.-Apr. 1967). (In Russian).

The Rogowski loop performance for measuring currents in nanosecond pulses was evaluated using a formula which permitted computing the frequency characteristics and the magnitude of false signals from external fields. The design and electric data of loops used in experiments with electron acceleration of plasma in toroidal systems are included. (tr-auth)

39992 ATTEMPTED MICROWAVE MEASUREMENT OF TEMPERATURE OF A SHOCK-HEATED PLASMA. Aro, T. O.; Walsh, D. (Oxford Univ.). Phys. Fluids, 10: 1468-76(July 1967).

Microwave noise radiation offers a simple probeless way of measuring the electron temperature of a hot plasma. The main difficulty usually lies in giving a true value to the emissivity. The temperature of the equilibrium region behind shocks in argon has been determined from the measurement of the microwave noise emitted by the shock-ionized argon in a shock tube and the absorption coefficient of the ionized gas measured at the same frequency, 9.05 GHz. The range of Mach numbers, 6.8 to 10.5, of shock in argon at an initial pressure of 4 mm Hg have been investigated experimentally and theoretically, and the smaller range of Mach numbers, 7.3 to 8.2, in which the measurements agree with theory is indicated. The measured temperatures in the latter range were between 4700 and 6000°K. Difficulties in interpreting some features of the results are discussed. (auth)

39993 OBSERVATIONS OF A RESONANCE PROBE EFFECT NEAR THE ION PLASMA FREQUENCY. Toepfer, Alan J. (Aerospace Corp., El Segundo, Calif.). Phys. Fluids, 10: 1599-1600(July 1967).

The ion resonance effect, a phenomenon in which the rectified current to an ac-driven, positively biased Langmuir probe exhibits a peak near ion plasma frequency, is investigated experimentally. Results indicate that the resonance occurs above the ion plasma frequency. (auth)

39994 ELECTRON TEMPERATURE SHOCK STRUCTURE IN A PARTIALLY IONIZED GAS. Leonard, B. P. (Royal Melbourne Inst. of Tech.). Phys. Fluids, 10: 1589-91(July 1967).

A study of the shock structure shows that the value of the electron temperature at the parent gas subshock has a limiting behavior for a monatomic gas and a singular overshoot for a diatomic gas as the Mach number is increased. (auth)

39995 MEASUREMENT OF β, n, AND T_i IN HIGH- AND LOW-PRESSURE THETA-PINCH OPERATION. Sawyer, G. A.; Finlayson, V. A.; Jahoda, F. C.; Thomas, K. S. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 10: 1564-8(July 1967). (LA-DC-8227).

Three coordinated measurements on the Scylla III theta-pinch yield: β, which is the ratio of plasma pressure to external magnetic field pressure; n, which is the plasma density as a function of radius; and T_i, which is the ion temperature. The three measurements are (1) a differential magnetic loop-probe measurement that determines total flux excluded by the plasma, (2) side-on-measurement of the profile of light intensity emitted by the plasma that yields the relative density profile, and (3) a side-on gas-laser interferometer measurement that gives the absolute density integrated through the plasma. Electron temperature is measured separately by x-ray absorption and it is assumed that electron and ion temperatures are not a function of radius. In the low-pressure regime, (P initial = 20 mtorr) without bias magnetic field, typical measured values are $\beta = 0.70 \pm 0.15$ and $n_e = n_i = 3.0 \times 10^{16}/cm^3$ on axis, $T_i = 2.2$ keV, and the plasma density decreases monotonically with increasing radius from the axis, reaching zero at r = 1.1 cm. In the high-pressure regime, (P initial = 100 mtorr) with reverse-bias magnetic field, typical values are $\beta = 0.85 \pm 0.15$ and $n_e = n_i = 3.5 \times 10^{16}/cm^3$ on axis, $T_i = 1.5$ keV, and the plasma density has a central core of radius ~0.8 cm of nearly constant density. (auth)

39996 PLASMA STATE IN A COAXIAL ACCELERATOR. Lie, T. N. (Catholic Univ. of America, Washington, D. C.); Ali, A. W.; McLean, E. A.; Kolb, A. C. Phys. Fluids, 10: 1545-52 (July 1967).

Spectroscopic measurements of electron temperature and density are reported for plasmas produced in a coaxial accelerator filled with helium to a static pressure of 0.5 to 1.0 torr. Luminous front velocities of ~6 cm/μsec were attained. Since the validity of these measurements depended on the assumption of local thermal equilibrium, the collisional and the radiative processes which determine the population densities of HeIII, and the various bound states of HeII and HeI, are examined. It is concluded that the local thermal equilibrium assumption is in fact a satisfactory approximation for the conditions of this experiment, i.e., the actual tem-

perature deviates by no more than 10 to 15% from the local thermal equilibrium value. Electron temperatures and densities were found to be ~4.0 eV and ~10^{17} cm^{-3}, respectively, in the region outside the end of the accelerator but before the plasma focus. Density distributions were found to vary greatly in the radial direction and to have strong dependence on polarity effects. For the case of a positive inner electrode, a large fraction of the gas was found to "snowplow" at the plasma front. (auth)

39997 HIGH POWER RF PLASMA ACCELERATOR. Briand, P.; Consoli, T.; Mourier, G.; Slama, L.; Vial, P. (CEN, Saclay, France). 8p. (CONF-661041-7). DTIE.

From 1st European Conference on Controlled Fusion and Plasma Physics, Munich.

Low-pressure plasma experiments in a circular waveguide, in the TE_{11} mode, are discussed. Pressures vary from 10^{-4} to 10^{-6} torr; rf power, from 100 watts cw to 1 MW pulsed at 1250 Mc. The problem of obtaining both energy and density in low- and high-energy discharges is discussed. (M.O.W.)

Kinetics of Plasma

39998 (ARL-67-0102) NONLINEAR MIXING OF WAVES IN A PLASMA WITH VELOCITY-DEPENDENT COLLISIONS. Shkarofsky, Issie P. (RCA Victor Co., Ltd., Montreal Quebec). Research Labs.). May 1967. Contract AF33(615)-2196. 41p. CFSTI.

The frequency difference, sum and second harmonic currents, due to two interacting waves in a plasma with no external magnetic field, are calculated. The oscillation frequencies are taken to be sufficiently high that ion motion can be neglected. The regime where Landau damping is negligible compared to collisional damping is considered. The nonlinearity is due to gradients in the ac electric fields. The form of the zero order isotropic and nonoscillatory part of the velocity distribution function is left arbitrary. The velocity dependences of the collision frequency of electrons with neutrals, ions and other electrons are properly accounted for. The Fokker–Planck equation in its integro-differential form and including nonlinear terms is used for electron–electron collisions. The self-consistent electric field is included with nonlinear terms. Results are given (a) for any degree of ionization provided the lowest frequency in the mixing process is greater than the total collision frequency and (b) for a slightly ionized gas for any ratio of oscillation to collision frequency. In the former case, it is shown that electron–electron effects do not contribute to the nonlinear current arising from wave mixing but contribute to the nonlinear self-consistent electric field. (auth)

39999 (ARL-67-0103) ON THE EVOLUTION OF THE PROBABILITY DISTRIBUTIONS AND OF THE CORRELATION FUNCTIONS IN A BOGOLUBOV PLASMA. Fritz, A.; Radin, S.; Sandri, G. (Aeronautical Research Associates of Princeton, Inc., N. J.). May 1967. Contract AF33(615)-1910. 42p. CFSTI.

A matrix formulation of nonequilibrium statistical mechanics was extended to the Bogolyubov gas ($\Phi_0/kT = 1/nr_0^3 \ll 1$). The asymptotic behavior is calculated for times long compared with the plasma frequency for: (i) the probability distribution functions, and (ii) the Mayer correlation functions. The collision integrals that determine the higher order kinetic equations for the Bogolyubov gas are thereby constructed. The calculations performed directly with the nonlinearly coupled Mayer functions are shown to be equivalent to those performed with the linearly coupled probability distribution functions. In lowest order the theory coincides with a result obtained previously by Bogolyubov. (auth)

40000 (DLR-FB-66-74) ARBEITSBLAETTER ZUR BERECHNUNG DER PLASMABESCHLEUNIGUNG IN GEKREUZTEN FELDERN. (Worksheet for the Calculation of Plasma Acceleration in Crossed Fields). Stoffers, G. (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Strahlantriebe). June 1966. 23p. (In German). Dep.

Includes drawings.

For the plasma acceleration in crossed electromagnetic fields, the equation of motion is integrated for the case of constant flow area, constant electric field strength, and constant magnetic induction, the flow being treated as a one-dimensional problem. From the integrated equation of motion, nomographs are derived for the graphical evaluation of the mutual relations between the velocity, the pressure, the electric field strength, the magnetic induction, and the employed electric work. The so-called velocity of momentum rate is used as an auxiliary quantity. (auth)

40001 (NP-16979) FIELD EQUATIONS FOR WAVES IN AN INHOMOGENEOUS WARM PLASMA WITH A FREQUENCY NEAR THE SECOND HARMONIC OF THE ELECTRON CYCLOTRON FREQUENCY. Report 67-37. Rem, J.; Weenink, M. P. H. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Apr. 1967. 25p. Dep.

Equations are derived that describe the electric fields inside the plasma when the frequency of the incident wave is in the neighborhood of the second harmonic of the cyclotron frequency. The equations were derived by two methods, one consisting of integration of the Vlasov equation along the unperturbed orbits of the particles and and the other starting from the moment equations. (M.O.W.)

40002 (SC-RR-67-289) MULTIFLUID THEORY FOR THE STAGNATION FLOW OF A PREIONIZED GAS. Johnson, D. H.; Touryan, K. J. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 41p. Dep. CFSTI.

Governing equations and boundary conditions are developed for the stagnation flow of a partially ionized monatomic plasma over a biased body using the multifluid theory. The transport properties and collision integrals for the various plasma species are discussed in detail. In practice, the flow of a supersonic preionized gas over a blunt body has applications in the areas of arc jet diagnostics and evaluation of arc jets as simulation devices for materials testing. (auth)

40003 (AD-653553) THERMODYNAMIC AND GAS-DYNAMIC PARAMETERS OF LOW-TEMPERATURE PLASMA. Bazhenova, T. V.; Zaytsev, S. G.; Kon'kov, A. A.; Makarov, Yu. V.; Pleshanov, A. S.; Samuylov, E. V.; Chekalin, E. K. Translated from Paper Presented at Mezhdunar. Simp. Svostvam Primen. Nizkotemp. Plazmy XX-om, Mezhdunar. Kongr. Teor. Prikl. Khim., Moscow, 1965. 11p. (FTD-MT-65-526; CONF-650723-2). CFSTI.

Properties of low-temperature plasma on diaphragm and electromagnetic shock tubes are discussed. A description is given of the methods of the experiment. As a result of the work, tables are compiled of thermodynamic and gas-dynamic parameters of air, carbon dioxide, nitrogen, and alkali metals for temperatures of 1000 to 20,000°K over a wide range of pressures. Certain experimental data are obtained on the nonequilibrium properties of plasma. (auth)

40004 RAMAN SCATTERING OF SUPERHIGH-FREQUENCY RADIATION BY THE ION-ACOUSTIC OSCILLATIONS OF A FINITE PLASMA. Ryutov, D. D. Dokl. Akad. Nauk SSSR, 173: 73-5(Mar.-Apr. 1967). (In Russian).

The problem of the influence of finite plasma dimensions on the process of scattering is investigated for the case of a flat plasma layer with a finite thickness. When the length of the incident electromagnetic wave is small in comparison with the layer's thickness, the frequency shift in scattering is negligibly small and the detection of the small signal in the Raman frequency on the background of the large signal may present great experimental difficulties. It is shown, however, that when the wavelength is larger than the plasma's cross section, the distance between the satellites becomes considerable. Formulas derived for the calculation of scattered radiation intensities indicate that it will be possible to verify the effect experimentally. (ATD)

40005 RADIATION OF AN ANTENNA IN A COMPRESSIBLE MAGNETOPLASMA. Deschamps, Georges A. (Univ. of Illinois, Urbana); Kesler, Oren B. Radio Sci., 2: 757-67(Aug. 1967).

The far field produced by an arbitrary monofrequency source in a compressible magnetoplasma is expressed in terms of the modal plane waves in the medium. The field φ is made up of the electromagnetic field and the velocity–pressure field of the electrons. Its sources may include, besides electric and magnetic currents, forces acting on the electrons and sources of electrons. A modal plane wave φ_k satisfies the source-free wave equation and at a given frequency ω is determined, except for a factor, by its wave vector k. The extremity of k lies on a dispersion surface $\mathfrak{S}_\omega$ depending on the frequency. The far field at point x is represented by $1/r\Sigma a(k)\varphi_k$ where the wave vectors k are such that the outward normal to $\mathfrak{S}_\omega$ at point k is in the direction of x. The φ_k being chosen to have unit energy flow vectors, the coefficients a(k) are simply related to the geometrical properties of the surface $\mathfrak{S}_\omega$ and to the Fourier transform of the sources on that surface. (auth)

40006 DIFFRACTION BY A CYLINDER IN A LOCALLY UNIAXIAL MEDIUM WITH AZIMUTHAL OPTIC AXIS. Stalzer, Henry J. Jr.; Shmoys, Jerry (Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.). Radio Sci., 2: 821-32(Aug. 1967).

An exact solution of Maxwell's equations is given for the problem of a magnetic line source parallel to the axis of a perfectly conducting cylinder in an inhomogeneous uniaxial medium of infinite extent. The inhomogeneity is due to the curvature of the lines of force of the static magnetic field responsible for the anisotropy of the medium. These lines of force are taken to be concentric with the cylinder. The exact solution is transformed, for fre-

quencies above the plasma frequency and for large cylinder radius, to a more rapidly convergent form which is given a geometric interpretation. This geometric interpretation can then be used to obtain approximate solutions when the magnetic field and the scatterer are more complicated and do not admit an exact solution of Maxwell's equations. (auth)

40007 PROPAGATION OF OBLIQUE ELECTROMAGNETIC WAVES THROUGH A WARM PLASMA SLAB WITH NORMAL MAGNETOSTATIC FIELD. Chawla, B. R.; Kalluri, D.; Unz, H. (Univ. of Kansas, Lawrence). Radio Sci., 2: 869-79(Aug. 1967).

Reflection, transmission, and absorption coefficients for oblique electromagnetic waves with parallel polarization incident on a warm plasma slab with a static magnetic field normal to its boundary, are studied. The effect of variation in the angle of incidence, the static magnetic field, the slab width, the plasma temperature, and the collision frequency on the various coefficients is shown graphically. It is found that the transmission coefficient increase in the plasma temperature. A change in the magnetostatic field strength decreases the transmission coefficient in one frequency region while it increases it in the other. For wave frequencies greater than cyclotron frequency, a sharp cutoff phenomenon occurs in the reflection coefficient at some angle. The absorption coefficient is found to be greater for larger slab width, except at a small frequency region where it shows oscillations. (auth)

40008 REFLECTION OF CIRCULARLY POLARIZED ELECTROMAGNETIC WAVES FROM AN ANISOTROPIC PLASMA. Bachynski, M. P.; Gibbs, B. W.; Graf, K. A. (RCA Victor Research Labs., Montreal). Radio Sci., 2: 881-92(Aug. 1967).

The reflection of both right-hand and left-hand circularly polarized plane electromagnetic waves normally incident along the direction of an imposed static magnetic field in an anisotropic plasma has been investigated. Detailed measurements at a frequency of 9.2 Gc of the intensity and phase of the wave reflected from a helium afterglow plasma over wide ranges of plasma frequency and electron-cyclotron frequency were carried out. The measured reflected power varied from less than 1 percent of the incident power to complete reflection, and large undulations in both intensity and phase of the reflected wave with changing electron density and magnetic field were observed. Comparison with theory based on a simple sharply bounded uniform plasma slab shows good agreement for the general nature of the dependence of the reflected wave on the plasma properties. The exact electron densities corresponding to the maxima and minima and the absolute values of the intensity and phase of the reflected wave are not accurately predicted by this simple theoretical model. In the region of the electron-cyclotron frequency, for an incident right-hand circularly polarized wave, the reflected signal undergoes a reduced variation in phase, and the intensity, after attaining a maximum, is observed to decrease with increasing electron density. (auth)

40009 PROPAGATION IN NONUNIFORM SLIGHTLY GYROTROPIC MEDIA. Gross, Stanley H. (Cutler-Hammer, Inc., Deer Park, Long Island, N. Y.). Radio Sci., 2: 893-904(Aug. 1967).

A previous paper presented the basic theory of propagation in nonuniform gyrotropic media in terms of an E and H mode representation. The representation results in a type of coupling that is independent of the rate of variation in the medium and thereby permits the study of regions with strong inhomogeneities along the gyrotropic axis. The coupling between modes arises due to the deviation of the gyromagnetic parameter $Y = \omega_c/\omega$ from zero and infinite values. The earlier paper provided solutions for models with $Y > 1$. In this presentation, details will be given for the $Y < 1$ case which is pertinent for propagation in the ionosphere at medium and higher frequencies. An iterative expansion procedure is employed, as previously, and some general properties are deduced from the solutions. The analysis is applied to the evaluation of the far field radiated by an electric current element exterior to a parabolic electron density layer. These results are applicable to the study of propagation through an ionospheric layer or an ionospheric irregularity. (auth)

40010 BIORTHOGONAL EXPANSIONS FOR THE LINEARIZED ANISOTROPIC MULTIFLUID WARM PLASMA EQUATIONS. Sancer, Maurice I. (TRW Systems, Redondo Beach, Calif.). Radio Sci., 2: 927-35(Aug. 1967).

A biorthogonality relation is presented between the eigenfunctions of the operator representing the linearized anisotropic multifluid description of a cylindrical warm plasma and the eigenfunctions of the corresponding adjoint operator. This biorthogonality relation is used to describe the solution to the plasma equations when the plasma is excited by general sources, as well as to decompose a known solution into the appropriate eigenfunction expansion. (auth)

40011 MAGNETIC PROPERTIES OF RELATIVISTIC PLASMA. Ruban, V. A. (Leningrad Polytechnic Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 67-74(1967). (In Russian).

Magnetic properties of equilibrium relativistic plasma in arbitrary magnitude fields in Boltzmann (high-temperature electron–positron mixture in the supernova shell) and quantum (superdense degenerate electron relativistic gas in white-dwarf-type stars) cases were studied, using calculations carried out as closed thermodynamic functions. It was found that the de Haas–van Alphen effect is conserved in the case of a degenerate free electron gas. (R.V.J.)

40012 MAGNETOHYDRODYNAMICS OF PLASMAS. Thompson, W. B. (Oxford Univ.). pp 156-62 of Magnetism and the Cosmos. Hindmarsh, W. R.; Lowes, F. J.; Roberts, P. H.; Runcorn, S. K. (eds.). New York, American Elsevier Publishing Co., 1967.

The equations of magnetohydrodynamics give an approximate description of the dynamics of a plasma. The equations are discussed in terms of the transport coefficients, collisionless MHD, and kinetic effects. (W.D.M.)

40013 PROPERTIES OF THE FOKKER–PLANCK EQUATION. Liboff, Richard L.; Fedele, James B. (Cornell Univ., Ithaca, N. Y.). Phys. Fluids, 10: 1391-1402(July 1967).

It is shown that the stochastically derived Fokker–Planck collision term, J_F, satisfies the conservation equations regardless of the form of the interparticle force law. The form of J_F for inverse power potential laws is obtained, and is compared with the form obtained from the expansion of the Boltzmann collision integral about grazing collisions. The two expressions are equal for the Coulomb case only. The expanded Boltzmann operator fails to satisfy the conservation laws for any other inverse power potential law. The relation between the "diffusion" coefficient b and the "friction" coefficient a, $\nabla \cdot b = a$, is found to hold only for the r^{-1} interparticle potential. An H theorem is presented for the Fokker–Planck collision term. (auth)

40014 NONLINEAR STUDY OF VLASOV'S EQUATION FOR A SPECIAL CLASS OF DISTRIBUTION FUNCTIONS. Berk, H. L.; Roberts, K. V. (Univ. of California, San Diego, La Jolla). Phys. Fluids, 10: 1595-7(July 1967).

Calculations on the "water-bag model" of a two-stream instability have been made by following the motion of the phase space boundaries. A large scale nonlinear wave is observed to evolve due to the condensation of holes in phase space. (auth)

40015 JUMP CONDITIONS FOR A TWO-FLUID PLASMA. Sen, Amiya K.; Spero, Donald M. (Columbia Univ., New York). Phys. Fluids, 10: 1597-9(July 1967).

The hydromagnetic jump conditions are derived for the two-fluid model of a plasma. Relevance to shocks in collisionless plasmas is discussed. (auth)

40016 EFFECT OF ROTATION ON THE GROWTH OF ALFVEN WAVE. Nariboli, G. A. (Iowa State Univ. of Science and Technology, Ames). Phys. Fluids, 10: 1591-3(July 1967).

The presence of rotation leads to a nonvanishing rate of growth of the discontinuity across an Alfvén wave front. The differential equations describing the growth are integrated completely when the state ahead is steady, but otherwise arbitrary. (auth)

40017 STEADY-STATE THEORY OF A LOW-PRESSURE DISCHARGE COLUMN IN AN AXIAL MAGNETIC FIELD. Self, S. A. (Stanford Univ., Calif.). Phys. Fluids, 10: 1569-76(July 1967).

A steady-state theory of a low-pressure discharge column in a magnetic field is derived in terms of the moment of the Boltzmann equation. For the electrons, the first-two moment equations are used with a scalar pressure. For the ions the first-three moment equations are used with an adiabatic assumption. Numerical solutions are given for the profiles of velocity, potential, density and ion stress tensor for both planar and cylindrical geometry for ranges of the parameters of practical interest. (auth)

40018 CYCLOTRON HARMONIC RESONANCES IN AN ELECTRODELESS DISCHARGE. Tetenbaum, S. J. (Lockheed Palo Alto Research Lab., Calif.). Phys. Fluids, 10: 1577-83 (July 1967).

Electron-cyclotron harmonic resonances in rf-excited, electrodeless, helium discharges have been investigated experimentally. The discharge simulates a plasma slab of relatively uniform magnetic field. Measurements were made at 9.15 GHz of both incoherent emission and coherent fundamental wave propagation, the microwaves propagating in a direction perpendicular to the magnetic field and normal to the slab boundaries. Emission resonances were found for both ordinary and extraordinary wave propagation. Precise measurements of the magnetic field

at corresponding peaks for the ordinary and extraordinary waves show that the former occur at magnetic fields about 0.3% lower than that of the latter, independent of harmonic number, electron density and pressure. The ordinary wave resonances occur at the cyclotron harmonic within experimental error (0.1%). Resonances were found in the coherent fundamental transmitted and reflected waves and are due to resonance absorption. Their magnetic field positions always occur on the high magnetic field side of the cyclotron harmonic (by as much as 2.5%). (auth)

40019 PROTON GYRORESONANCE OBSERVED IN INCOHERENT SCATTERING FROM THE IONOSPHERE. Farley, Donald T. Jr. (Jicamarca Radar Observatory, Lima). Phys. Fluids, 10: 1584-6(July 1967).

A radar directed nearly orthogonal to the geomagnetic field was used to measure the autocorrelation function of the scattered signal. Peaks were observed at the first three multiples of the proton gyroperiod, in excellent agreement with theory. (auth)

40020 ADIABATIC TIME DEVELOPMENT OF LINEAR THETA-PINCH PLASMA PROFILES. Morse, Richard L. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Phys. Fluids, 10: 1560-3(July 1967). (LA-DC-8228).

The formation of a θ-pinch plasma sheath is studied under the assumption that the sheath is initially relatively thin and must therefore contain a radial E field but that later it relaxes to a thickness of the order of the ion gyroradius because of line shorting. A family of the resulting self-consistent equilibria are computed for a Maxwellian plasma under the additional assumption that the radial adiabatic invariant, $I_r = \oint P_r dr$, is conserved for all ions during the relaxation. These solutions predict that for particle line densities less than about 5×10^{16} cm^{-1}, this relaxation will allow enough penetration of B_z to the center of the plasma to cause β to be significantly less than one. The resulting plasma angular momenta are obtained. (auth)

40021 QUASI-STATIC ION CYCLOTRON WAVES. Swanson, D. G. (Univ. of Texas, Austin). Phys. Fluids, 10: 1531-4(July 1967).

Experiments by Kristiansen and Dougal have shown that ion cyclotron waves propagate in broad bands above the ion cyclotron frequency, and hence that finite Larmor radius effects are important even in moderate temperature plasmas. Investigation of the quasi-static dispersion relation leads to the observed features when the wavelength perpendicular to the field is allowed to be small compared to the Larmor radius. Results indicate that finite Larmor radius effects can dominate the dispersion relation, that the parallel wavelength is independent of density when they do, and that a maximum ion temperature from ion cyclotron resonance heating exists for quasi-static waves which depends only on the phase velocity parallel to the magnetic field. (auth)

40022 MAGNETOHYDRODYNAMICS IN A REACTING MEDIUM. Liboff, Richard L.; Caroff, Lawrence J. (Cornell Univ., Ithaca, N. Y.). Phys. Fluids, 10: 1492-8(July 1967).

The effect of ionization and recombination on the propagation of waves through a three-component, magnetoactive plasma is examined in the magnetohydrodynamic limit. Ionization and recombination are assumed to result from several types of reactions. A new set of nonlinear equations is derived to describe the dynamic behavior of the system. To first order in the coupling frequencies, the magnetohydrodynamic waves are exponentially damped with a time constant which is isotropic for the Alfvén mode and slightly anisotropic for the fast and slow modes. The sound mode in the neutral fluid is damped with a time constant which is also isotropic. All modes are stable. (auth)

40023 SINGULARITIES OF THE TWO-FLUID PLASMA EQUATIONS AND THEIR RELATION TO BOUNDARY CONDITIONS. Friedman, Herbert W.; Levi, Enrico (Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.). Phys. Fluids, 10: 1499-1506(July 1967).

The one-dimensional fluid equations are used to describe a steady state, slightly ionized plasma confined by cold walls. The singularities of the complete two-fluid and approximate one-fluid equations are investigated and compared. It is found that the singularity in the one-fluid equations, indicating a transition from plasma to sheath regions, disappears in the two-fluid equations and therefore a smooth transition is predicted. Another singularity which is present in the two-fluid but not in the one-fluid equations is shown to be compatible if a constraint relation is satisfied at the singular point. In order that the two-fluid problem be well posed—(1) the boundary conditions are modified to ensure that the constraint relation is satisfied, and (2) a kinetic model is derived which uniquely specifies the wall potential for a given plasma configuration. The occurrence of a compatible singularity is shown to be analogous to the phenomenon of transonic flow in a convergent–divergent nozzle. (auth)

40024 POWER SERIES EXPANSION OF THE ELECTRON VELOCITY DISTRIBUTION FUNCTION. Morrone, Terry (Adelphi Univ., Garden City, N. Y.). Phys. Fluids, 10: 1507-11(July 1967).

A power series expansion of the harmonic expansion coefficients of Margenau and Hartman is introduced. In principle all the harmonic coefficients may be computed using the expansion. The expansion parameter is the fraction of energy lost per collision or equivalently the electric field strength. By way of example the third and fifth harmonic electric current densities in a plasma are computed. (auth)

40025 ELECTRON DISTRIBUTION FUNCTION IN A PLASMA WITH EXCITATION COLLISIONS. Mjolsness, R. C.; Petschek, A. G. (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 10: 1511-18(July 1967).

The electron distribution function is obtained for a spatially uniform, steady-state plasma having electron–electron, electron–ion and excitation collisions. The Fokker–Planck terms are linearized and the field-particle distribution functions are approximated by highly singular functions which reproduce the first three moments of Maxwellian distributions. Approximate self-consistency of the procedure is shown. The simplification is such as to permit the second-order difference-differential equations describing the electron distribution function to be solved in simple analytic form. For energies larger than the excitation energy, the solution is a Maxwell distribution with an altered electron "temperature" which depletes the tail of the distribution. The solution is examined in various limiting cases, and its effect on reducing ionization rates in the plasma is discussed. (auth)

40026 EQUILIBRIUM AND LINEAR RESPONSE OF A CLASSICAL SCALAR PLASMA. Kalman, G. (Univ. of Colorado, Boulder). Phys. Rev., 161: 156-65(Sept. 5, 1967).

The properties of a classical many-particle system interacting through a scalar field (a scalar plasma) are studied. A relativistic Hartree approximation is applied to equilibrium to evaluate thermodynamic characteristics such as the energy, entropy, and equation of state. A gas–liquid phase transition appears at moderate densities. There is no collapse for an attractive interaction; the system can accommodate any density. Stability against small perturbation and the behavior of collective excitations are analyzed through the linear-response function. (auth)

40027 ION-WAVE INSTABILITIES IN MERCURY-VAPOR PLASMA. Tanaca, H.; Hirose, A.; Koganei, M. (Yokohama National Univ., Japan). Phys. Rev., 161: 94-101(Sept. 5, 1967).

The Landau dispersion equation $2k^2 = k_{De}^2 Z'(\zeta_e) + k_{Di}^2 Z'(\zeta_i)$ is studied experimentally for $\omega = \omega_r + i\omega_i$, where $\omega_i = 0$ determines the stable–unstable boundary of ion waves, k_{De} and k_{Di} are the electron and ion Debye wave numbers, and $Z(\zeta)$ is the plasma dispersion function. The decrease of the phase velocity with the frequency predicted by dispersion relation is observed for the spontaneously excited ion waves in the mercury-vapor discharge. The cutoff frequency beyond which no ion waves appear is also observed. The cutoff frequency increases with the electron drift velocity in the plasma. The dependence of the cutoff frequency on the electron drift is explained by the ion-wave instability in a two-Maxwellian-component plasma. One-way propagation of externally excited ion waves is also shown. (auth)

40028 COOPERATIVE LIGHT SCATTERING FROM θ PINCH PLASMAS. Daehler, Mark; Ribe, F. L. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Phys. Rev., 161: 117-25(Sept. 5, 1967). (LA-DC-8717).

Results are reported of an experiment to measure the cooperative scattering from density fluctuations in the plasma of a 150-kJ, high-voltage θ pinch with a low-pressure (20 m torr) filling of deuterium gas. The beam from a giant-pulse ruby laser is focused at the center of the plasma, and the light emerging at angles between 5.5° and 7° to the beam and plasma axis is collected and spectrally resolved by a spectrometer consisting of an interference filter and two identical Fabry–Perot interferometers in series. The θ-pinch plasma parameters, separately measured in another experiment, are plasma density $n = 2.8 \times 10^{16}$ cm^{-3}, $kT_e = 345$ eV, and $kT_i = 2.0$ keV, corresponding to Salpeter's $\alpha = 1.2$, $\beta = 0.33$. Scattered spectra are reduced to absolute values of $nd^2\sigma/d\Omega d\lambda$ by calibration against Rayleigh scattering from dry N_2 gas. The results show a narrow central peak superimposed on a broader tail of lower magnitude. In the case of no bias field ($B_0 = 0$), the tail has a width and magnitude equal within experimental error to those of the theoretical thermal-ion feature, corresponding to Doppler broadening of the scattered light by an amount characteristic of the thermal-ion motion at $kT_i = 2$ keV. The central

peak has a maximum magnitude 15 times greater than that of the theoretical ion feature, and is 0.44 times as wide. For $B_0 = -750$ G, the central peak increases in intensity by another factor of 3, while retaining approximately the same width. The central peak is attributed to superthermal-plasma density fluctuations, superimposed on the background represented by the broader thermal-ion feature. (auth)

40029 MEASUREMENTS OF ELECTRIC FIELDS AND PLASMA VELOCITIES IN THE BOGEN. Mahn, C.; Ringler, H.; Zankl, G. (Institut fuer Plasmaphysik, Garching, Ger.). 6p. (CONF-661041-12). DTIE.

From 1st European Conference on Controlled Fusion and Plasma Physics, Munich.

The following effects on a plasma in an arc discharge are studied: the influence of the axial magnetic field on the thermal conductivity, the pressure increase in the arc related to currents in the azimuthal direction, and the rotation of the whole plasma caused by currents in the radial direction. (M.O.W.)

40030 PLASMA ROTATION IN A PULSED INDUCTIVE ACCELERATOR. Dailey, C. L. (TRW Systems, Redondo Beach, Calif.). 5p. (CONF-661051-1). DTIE.

From 17th International Astronautical Congress, Madrid.

Plasma acceleration in an inductive accelerator is shown to be partially due to ion current produced by the induced azimuthal electric field in a layer whose thickness is about half of the ion gyro radius. This behavior implies plasma rotation. A survey with miniature probes shows that any torque that could be produced by $j \times B$ forces is at least an order of magnitude less than that due to the electric field. (M.O.W.)

40031 LOW FREQUENCY WAVES IN A BEAM-PLASMA SYSTEM. Matitti, T.; Vermeer, A.; Hopman, H.; Cabral, J.; Kistemaker, J. (FOM-Inst. for Atomic and Molecular Physics, Amsterdam). 19p. (CONF-661041-11). DTIE.

From 1st European Conference on Controlled Fusion and Plasma Physics, Munich.

The interactions between a thin unmodulated electron beam and its own created plasma, in the presence of a longitudinal B field, are studied. For not very high values of the B field (less than 800 gauss), a clear instability occurs in the surroundings of the ion–plasma frequency. On the basis of the theory for a waveguide filled with a homogeneous plasma and electron beam, this instability is identified as the interaction between the slow cyclotron wave on the beam and the plasma wave. From measurements of wavelengths it appears that the unstable wave propagation is confined to a cone between 87 and 90° with respect to the B field. (auth)

40032 NON-LINEAR EFFECTS IN A BEAM-PLASMA SYSTEM. Hopman, H. J.; Matitti, T.; Cabral, J.; Vermeer, A.; Kistemaker, J. (FOM-Inst. for Atomic and Molecular Physics, Amsterdam). 23p. (CONF-661041-10). DTIE.

From 1st European Conference on Controlled Fusion and Plasma Physics, Munich.

Investigation of the electron-plasma instability, in a dc beam–plasma experiment, reveals two types of nonlinear behavior. As a function of time, the amplitude of the instability is pulsed, the pulses coming at random. Spatially, the amplitude shows an interference pattern, with a wavelength decreasing monotonously if the instability is scanned at a fixed frequency from the gun to the collector. It is attempted to give an explanation for the latter effect, by stressing the difference between waves propagating parallel or antiparallel with the beam. Due to the electron beam, the dielectric tensor is anisotropic, and waves in opposite direction propagate at different speeds. (auth)

40033 CHARACTERISTICS OF AN $\vec{E} \times \vec{B}$ DISCHARGE. Bannenberg, J. G.; Brakenhoff, G. J.; Kistemaker, J. (FOM-Inst. for Atomic and Molecular Physics, Amsterdam). 11p. (CONF-661041-8). DTIE.

From 1st European Conference on Controlled Fusion and Plasma Physics, Munich.

In rotating plasma experiments internal shortcircuiting along B-field lines occurs often at very early times in the discharge even with puffed gas input. In an attempt to avoid this effect it was found that: (1) elongation of the magnetic field lines results in a delay of the internal crowbar, and (2) Pyrex cylinders, placed where field lines cross the outer electrode, suppress the crowbar completely. However, marked differences in the discharge with or without Pyrex are observed. Without Pyrex the current distribution in the outer electrode shows a dependence on Larmor radius. With Pyrex the current enters the outer electrode in a small annular area at the midplane of the magnetic bottle. The burning voltage is not proportional to B as is expected from the Alfvén velocity limit, but to B^2. This suggests a voltage limiting process connected with Larmor radius, which for the electrode constituents is about half the electrode distance at burning voltage. The thermal energy density decays at a constant rate of 80 μsec. The rotational energy density change on external crowbar has the same decay as the energy content determined from the back delivered current, allowing to estimate the plasma volume. The time constant for this decay starts with 20 μsec and gradually approaches the thermal energy decay time constant. (auth)

40034 INVESTIGATION OF STRONG BLAST WAVES AND THE DYNAMICS OF LASER INDUCED PLASMAS IN HIGH PRESSURE GASES. Friedrich, Otto M. Jr.; Weigl, Frederic; Dougal, Arwin A. (Univ. of Texas, Austin). 28p. (CONF-670926-1). DTIE.

From AIAA Joint Electric Propulsion and Plasmadynamics Conference, Colorado Springs, Colo.

Strong shocks produced when 2 to 3 joules of energy are released in high-pressure gases by focusing a giant pulse laser are investigated analytically and experimentally. Strong blast wave theory is employed to calculate the position, velocity, maximum pressure, and temperature as functions of time and energy absorbed by the gas in the shocks formed for several gases at pressures of 1 to 2000 atmospheres. Experimentally, luminous fronts associated with strong blast waves produced in gases at pressures up to 2000 atmospheres with a focused 30-MW, 40-nsec pulse ruby laser are observed with Kerr cell photography. Optical interferometry with a Mach–Zehnder interferometer, absorption of a helium–neon laser beam, and piezoelectric pressure-sensitive probe measurements of strong shocks produced in air at STP with a second giant pulse ruby laser (175 MW, 17 nsec) show that during the rapid radial expansion of the shock, the measured position agrees to within 10% of that calculated. Relatively strong pressure fronts are observed at radii in excess of 50 cm and are spherical for radii larger than 2 cm. (auth)

Production of Plasma

40035 (IHT-2-10) ZUENDUNG UND VORIONISIERUNG EINER IMPULS-ENTLADUNG MIT ZWEI ZUEINANDER SYMMETRISCHEN HOCHSPANNUNGS-FUNKEN UND EINER BOGENENTLADUNG. (Ignition and Pre-ionization of a Pulse Discharge with Two Symmetric High-Voltage Sparks and an Arc Discharge). Hisam, E.; Kimmel, H. (Technische Hochschule, Stuttgart (West Germany). Institut fuer Hochtemperaturforschung). Apr. 1966. 32p. (In German). (CONF-660448-8). Dep.

From the Meeting of the Professional Group on Plasma and Gas Discharge Physics, Kiel, Germany.

Various methods were used to investigate an arc discharge which was fed from a condenser battery and ignited so that, between the two arc electrodes, no ignition voltage difference occurred. The study showed only two of the arrangements tested are suitable. The arc so ignited burned axially with proportionally low turbulence. It can be used for the preionization of a high-current pulse discharge in the heating of a plasma. With the help of oscillograms and a fast camera the buildup of the arc discharge was followed accurately. In connection with the research carried out the uncontrollable effect of electromagnetic interspersions on the ignition device of the switch spark gap were shown as additional problems. These problems were solved for this device by the construction of a two-stage ignition device. (tr-auth)

40036 (NASA-TN-D-4150) VOLUME ION PRODUCTION COSTS IN TENUOUS PLASMAS: A GENERAL ATOM THEORY AND DETAILED RESULTS FOR HELIUM, ARGON, AND CESIUM. Dugan, John V. Jr.; Sovie, Ronald J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Sept. 1967. 47p. CFSTI.

A simple general theory for the volume ion production cost and ion production rate is presented for an arbitrary tenuous plasma having a Maxwellian distribution of electron energies. The ion production cost results are obtained by comparing the relative probabilities for the competing inelastic processes of excitation and ionization. The general theory treats a simplified atomic model and gives the volume ion production results for a general atom as a function of electron kinetic temperature. The results of this general theory are shown to be in good agreement with those of more detailed calculations for helium, argon, and cesium gases. These detailed results are obtained by considering the discrete atomic structure of the target atoms and are presented for two distinct cases: (1) a monoenergetic electron beam incident upon a cold neutral gas, and (2) the interaction of a thermal electron gas with cold neutrals. The semiclassical Gryzinski method was used to determine theoretically the cross sections needed for the general atom theory and the detailed argon and cesium studies. Experi-

mental excitation functions were used in the detailed helium calculations. The Gryzinski technique for calculating cross sections is discussed, and the results of this theory are compared with available experimental data. This comparison shows that the Gryzinski method generally gives absolute cross sections that are good to within a factor of two or better. Its application should not introduce significant error in an eV/ion calculation, however, since the relative rates of the processes involved are of interest and not their absolute magnitudes. (auth)

Stability of Plasma

40037 (NP-16976) MONOTONICITY OF THE STABILITY CRITERION FOR A PINCHED FLUID WITH A LONGITUDINAL MAGNETIC FIELD. Report No. 67-39. Bobeldijk, C. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Apr. 1967. 7p. Dep.

Normal mode analysis applied to perturbations of a pinched fluid with a longitudinal magnetic field leads to a well-known stability criterion. It is proved that the ω-dependent part of this criterion increases monotonically with the growth rate ω. (auth)

40038 (AD-644037) INSTABILITY OF THE CURRENT LAYER IN NONHOMOGENEOUSLY MAGNETIZED PLASMA. Shul'man, L. M. Translated from Byull. Sta. Opt. Nablyudeniya Iskusstvennykh Sputnikov Zemli, 10: 70-3(1964). 8p. (FTD-TT-66-19). CFSTI.

The one-dimension problem of plasma stability in the region of a neutral plane has been solved. The result shows that on account of the adiabaticity the plasma proves to be unstable. (auth)

40039 PLASMA DRIFT INSTABILITY IN SCREW MAGNETIC FIELD OF A STELLARATOR. Aleksin, V. F.; Yashin, V. I. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh., 12: 690-2 (Apr. 1967). (In Russian).

Following up previous studies on the conditions of the existence of unstable, localized drift waves in an inhomogeneous plasma within an axially symmetric magnetic field with helicoidal lines of force, similar drift waves occurring in a plasma within the helicoidal field of the stellarator were investigated. The authors' previously obtained expression for the electrical conductivity and polarizability tensors for low-pressure plasma were made use of in the calculations. The localized perturbations, the wave length of which greatly exceeds the distance between the maximal and minimal radii of the magnetic surface, were examined. Results of the calculations indicated that the helicoidal magnetic field of the stellarator may be assumed to be an axially symmetric one, the helicoidal lines of force of which coincide with the averaged lines of the stellarator; this makes it possible to use the previously derived calculations for defining the conditions of instability of the drift waves. (TTT)

40040 INFLUENCE OF STATIC, RADIAL, ELECTRIC FIELDS ON TRAPPED PARTICLE INSTABILITIES IN TOROIDAL SYSTEMS. Galeev, A. A.; Sagdeev, R. Z.; Wong, H. V. (IAEA, Trieste, Italy). Phys. Fluids, 10: 1535-9(July 1967).

The drift motion of trapped particles in toroidal systems leads to a new branch of gravitational instability. This is stabilized by radial electric fields. However, a new unstable mode then appears, which is similar to that due to ion impurity density gradients. (auth)

40041 USE OF TWO-DIMENSIONAL SLAB MODELS IN HYDROMAGNETIC STABILITY THEORY. Johnson, John L. (Princeton Univ., N. J.). Phys. Fluids, 10: 1519-22(July 1967). (MATT-510).

The use of two-dimensional models with a varying gravitational field to simulate the effect of curvature of the magnetic field lines is justified by a study of localized instabilities in general toroidal configurations. This clarifies the limitations of such models. (auth)

40042 TWO-STREAMING CYCLOTRON INSTABILITY. Hall, Laurence S.; Grewal, Mahesh S. (Univ. of California, Livermore). Phys. Fluids, 10: 1523-5(July 1967). (UCRL-70109).

A new electrostatic instability of counterstreaming ions occurring at cyclotron frequency is exhibited and discussed. It is conjectured that this instability may provide the mechanism for the enhanced trapping of the injected ion beam in DCX-II. Stability criteria are developed and in the limit of high anisotropy of the ions and not-too-cold electrons, the criterion becomes approximately $\frac{1}{2}M_i v_i^2 < kT_e/4$ (unstable), where M_i is the ion mass, v_i are the counterstreaming velocities, and T_e is the electron temperature. (auth)

40043 EFFECT OF MAGNETIC CURVATURE ON THE DRIFT-CYCLOTRON INSTABILITY. Krall, N. A.; Fowler, T. K. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 10: 1526-30(July 1967).

The effect of magnetic curvature on drift-cyclotron instabilities is examined. These instabilities, driven by the density gradient, are expected to be the most important electrostatic instabilities in well-thermalized (Maxwellian) plasmas. It is found for the flute mode, $K_{||} = 0$, that a moderate amount of good (cusp-like magnetic curvature stabilizes the longest wavelengths most likely to cause anomalous diffusion and shifts the unstable frequencies below the cyclotron frequency. Curvature does not stabilize the convective modes, $K_{||} \neq 0$, but these modes can be stabilized by avoiding resonance. Results are applied, speculatively, to average-B fields, for which an additional "communication" criterion is necessary for stability. (auth)

40044 DRIFT-CYCLOTRON INSTABILITY IN A TOROIDAL MACHINE. Bhadra, Dilip (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev., 161: 126-33 (Sept. 5, 1967). (GA-7689).

Low-frequency fluctuations have been observed in the plasma inside the toroidal machine at General Atomic. These excitations need high ion temperature and they occur where the plasma or the magnetic field is nonuniform. These oscillations propagate in the direction of the diamagnetic current with $k_{||} \ll k_{\perp}$. They have a rather peaked growth rate as a function of $k_{\perp}$ and are characterized by a narrow-band spectrum. It has been conjectured that the oscillations are due to a drift instability near the ion cyclotron frequency Ω_i obtained by Mikhailovskii and Timofeev, occurring in a machine with high simulated gravity. The appropriate dispersion relation has been solved numerically in the Univac 1108 digital machine after converting it into a pair of nonlinear simultaneous first-order differential equations and starting from solutions obtained analytically for large $k_{\perp}$. The solution for the mode investigated with $\omega \sim \Omega_i + k_{\perp}v_g$, where v_g is the gravitational drift, appears to have a prominent peak in the growth rate and a noticeably monochromatic frequency spectrum. If v_g is set equal to zero, this mode turns into the usual Mikhailovskii–Timofeev drift-cyclotron mode. Various other properties of the mode have been found, including an interesting density variation of frequency. (auth)

40045 THE HELICAL INSTABILITY OF THE POSITIVE COLUMN IN CROSSED FIELDS AND IN ANNULAR PLASMA CONFIGURATIONS. Holt, E. H.; Reynolds, J. F. (Rensselaer Polytechnic Inst., Troy, N. Y.). 10p. (CONF-670810-3). DTIE.

From 8th International Conference on Phenomena in Ionized Gases, Vienna.

The helical instability typical of collision-dominated plasmas has been investigated in the presence of transverse magnetic fields. In all cases the critical value of the magnetic field is very sensitive to an applied transverse component. A rectilinear transverse component destabilizes the discharge while a minimum B configuration has a strong stabilizing effect. A magnetic field with shear will destabilize the plasma if the shear is in the same sense as the incipient helical plasma perturbation but a shear of the opposite sense stabilizes the plasma. A coaxial plasma has been investigated in regard to its stability in a solenoidal field. It is found that improved agreement between theory and experiment for the prediction of the critical field value can be obtained if the radial form of the plasma density is taken into account in evaluating the stability criterion. When the coaxial plasma is immersed in a magnetic field with shear it is found that the consequent change in the radial form of the plasma density accounts for the major part of the change in the value of the critical magnetic field. (auth)

40046 INSTABILITY IN A ROTATING PLASMA. Barbian, E. P.; Rasmussen, C. E.; Kistemaker, J. (FOM-Inst. for Atomic and Molecular Physics, Amsterdam). 10p. (CONF-661041-9). DTIE.

From 1st European Conference on Controlled Fusion and Plasma Physics, Munich.

Gravitational instabilities can be studied in an $E \times B$ configuration where a radial electric field is applied independently from the magnetic field. This makes it possible to vary the parameter of the rotational velocity by intention and to study its influence of the growth rate of instabilities. The ionization starts near the negative central electrodes and a plasma is formed near the axis which slowly expands in radial direction and seems to undergo an $m = 1$ instability with a moderate growth rate. Measurements of the local radial electric field and optical observation shows that after the expansion the plasma becomes centered around the axis again, and stays away from the wall electrode. Out of small perturbations of the plasma surface a fast growing instability of higher mode ($m \approx 8$) develops after the current maximum. The measured growth rates depend on the local rotational velocity, which agrees with the theory of gravitational instabilities. The influence of Larmor stabilization can be neglected. Small growth rates of dis-

turbances with a low mode number can be understood by the charge separation out of phase which is produced by the Coriolis force. (auth)

Shielding

Refer also to abstracts 40353 and 40717.

40047 (ABS-THH-1019) EINE METHODE ZUR MESSUNG DER ZUWACHSFAKTOREN FUER GAMMASTRAHLEN IM ENERGIEBEREICH VON 0,5–15 MeV. (A Method for Measurement of the Growth Factors for Gamma Radiation in the Energy Region From 0.5 to 15 MeV). Futtermenger, W. (Technische Hochschule, Hanover (West Germany). Arbeitsgruppe fuer Bautechnischen Strahlenschutz). Feb. 1966. 100p. (In German). Dep.

Thesis.

A measurement principle is described which makes it possible to determine, in the calculation of shields, the required dose and energy absorption growth factors for γ radiation in the energy range from 0.5 to 15 Mev. The measurement arrangement avoids large radiation fields. A narrow shielded beam penetrates a shield model. The spectrum of the γ radiation emitted was measured in the beam and in the lateral scattered radiation field separately. From both fractions the growth factors were derived. With an electron accelerator as bremsstrahlung generator and a NaI scintillation crystal as a detector, high sensitivities were attained and large layer thickness investigated. Growth factors for monoenergetic radiation were obtained on the variation of the maximum energy of the bremsstrahlung used. The method was tested with Fe as shielding material so that a comparison could be carried out with the theoretical growth factors for Fe. The growth factors obtained are, in all cases, within the limits of error of these comparison values. In an additional measurement series the previously unknown dose growth factors of a barite concrete were determined. (tr-auth)

40048 (ABS-THH-1025) BERECHNUNG VON GAMMA-STRAHLUNGS-ZUWACHSFAKTOREN IN GESCHICHTETEN SCHILDEN. (Calculation of the Gamma Radiation Growth Factor in Layered Shields). Schubart, H. (Technische Hochschule, Hanover (West Germany). Arbeitsgruppe fuer Bautechnischen Strahlenschutz). Dec. 1965. 28p. (In German). Dep.

A method is derived for the approximate calculation of the growth factors in multilayered shields. The empirical coefficients α and β are then determined. Results are given for Fe/H_2O, H_2O/Fe, Pb/H_2O, and H_2O/Pb layers. A program for the approximate calculation of the growth factor is set up. (J.S.R.)

40049 (AWRE-O-100/63) NUMERICAL SOLUTION OF PROBLEMS IN RADIATION HYDRODYNAMICS. Grant, I. P. (Atomic Weapons Research Establishment, Aldermaston (England)). [nd]. 32p. Dep.

The basic equations of radiation hydrodynamics are set forth, and a set of conservative difference equations for their numerical solution in plane and spherical geometry is constructed. An unconditionally stable set of difference equations for numerical solution of the (stationary) radiative transfer equation is described without proof. The characteristics of the GARTH (grey radiative transfer) and JOSEPH (non-grey radiative transfer) codes are briefly described together with a brief list of the types of problems that have been successfully solved with their use. (auth)

40050 (ORNL-TM-1956) THE RADIATION SHIELDING INFORMATION CENTER COMPUTER CODES COLLECTION, 1963–1967. Maskewitz, Betty F.; Trubey, D. K. (Oak Ridge National Lab., Tenn.). Sept. 6, 1967. Contract W-7405-eng-26. 35p. Dep. CFSTI.

The Computer Codes Section of the Radiation Shielding Information Center was formed in 1963 to provide computer tools directly to the individual scientist or engineer who performs radiation transport calculations. The code collection has now grown to 85 large computer code packages (listed in an appendix), and shipments to code users are averaging 1.3 code packages per working day. Other information services connected with computer codes are performed at the rate of almost three per day. Since most persons in need of RSIC services are engaged in government-connected work, the Center is funded by the U. S. Atomic Energy Commission, the Defense Atomic Support Agency, and the National Aeronautics and Space Administration. An analysis of the acquisitions and services of the Codes Section shows that the universities and foreign scientists also participate substantially in the formation exchange. (auth)

40051 (RRA-M-67) THE EFFECT OF CUTOFF ENERGY ON MONTE CARLO CALCULATED GAMMA-RAY DOSE RATES IN AIR. Marshall, J. D.; Wells, M. B. (Radiation Research Associates, Inc., Fort Worth, Tex.). Oct. 31, 1966. 62p. (CONF-661001-50). Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

From 14th Conference on Remote Systems and Technology, Pittsburgh, Pa.

Monte Carlo calculations were made for the transport of gamma rays from a point isotropic source in an infinite air medium in which the particles are allowed to decrease in energy down to 0.01 MeV. These new calculations were prompted by discrepancies in dose buildup factors observed between earlier Monte Carlo calculations and those obtained from moments method data for infinite water. Inclusion of the low energy (0.01 to 0.10 MeV) component of the dose leads to good agreement between dose buildup factors for the two different calculational methods. The low-energy component contributes as much as 36% of the total dose from a 0.5 MeV point isotropic gamma-ray source after an equilibrium spectrum is obtained. Good agreement was obtained not only in the dose buildup factors but also in the energy spectra. It was concluded that Monte Carlo calculations for air and moments method data for water are compatible (within ±10%) when the gamma rays in the Monte Carlo calculations are allowed to scatter down to a low-energy cutoff of 0.01 MeV. (auth)

40052 (ORNL-tr-1671) STUDY OF THE METHODS FOR ANALYZING MULTILAYER GAMMA-RAY SHIELDS. Kataoka, Iwao. Translated for Oak Ridge National Lab., Tenn., from Senpaku Gijutsu Kenkyujo, 3: 161-343(1966). 196p. Dep. CFSTI. JCL $13.50 fs, $6.11 mf.

Two methods are presented for analyzing gamma rays in stratified slab shields. In Part I, a numerical integration method of the Boltzmann transport equation is described, which solves the equation at the discrete points of ordinates of spatial, angular, and energetic. Under the same interval of spatial mesh points, results of test calculations reveal that the method presented gives more correct attenuation of gamma fluxes than, for instance, the discrete S_n method does. A supplemental procedure is provided for a monoenergetic and monodirectional incident source besides the treatments for continuously distributed sources. Part II presents the Response Matrix method as well as a table of the response matrices in the Appendix. The transmission and reflection responses of the gamma rays for an elemental slab of each material were prepared with the Monte Carlo method for the gamma-ray injection of the unit intensity to the slab surface under a certain set of incident angle and energy. The transmitted or reflected gamma rays from a given stratified shield of different materials as well as single material are obtained by operating the response matrices of the elemental slabs composing the shield. The procedures for synthesizing and interpolating the response matrices are given. And the estimated errors accompanied with the procedures were evaluated. In Part III, various results of sample calculations are illustrated. The results computed with the present methods show good agreement with those from the moments method, Monte Carlo calculations, and the experimental measurements. (auth)

40053 CALCULATION OF SPACE-DEPENDENT NEUTRON SPECTRA IN IRON/WATER/IRON SHIELD ARRANGEMENTS. Fiebig, R. Atomkernenergie, 12: 259-66(1967). (In German).

Neutron spectra have been calculated in plain layered water/iron/water shields with a neutron transport program, BINE, for a study of the relationship of multigroup diffusion calculations to transport theory. The method is given and the results are discussed. (auth)

40054 EFFECT OF NEGLECTING TRANSIENTS IN MULTIGROUP-DIFFUSION CALCULATIONS IN PLAIN SHIELDING LAYERS. Fiebig, R. Atomkernenergie, 12: 249-58(1967). (In German).

The results of energy-dependent transport calculations in plain water/iron/water layers were used to calculate constants for multigroup diffusion calculations whose spatial variations are discussed. The dependence of layer-averaged constants on iron thickness is investigated. Using these constants a recalculation of neutron fluxes by a diffusion program showed a good agreement to transport results. (auth)

40055 MEAN GAMMA-RAY ENERGY ABSORPTION COEFFICIENTS. Unruh, W. G.; Tomlinson, M. (Atomic Energy of Canada Ltd., Manitoba). Nucl. Appl., 3: 548-9(Sept. 1967).

Mean-energy absorption coefficients have been calculated for H, C, H_2O, Al, Ar, Fe, Mo, Pb, and U for the published distribution of γ rays of a number of reactors and for certain other γ-ray spectra. An exponential distribution of γ-ray energies approximates many of the observed spectra and gives mean absorption coefficients that can be useful in the absence of detailed knowledge of a spectrum. (auth)

40056 APPARATUS FOR MEASURING α-PARTICLE RANGES IN LIQUIDS. Aniansson, Gunnar (Royal Inst. of Tech., Stockholm). Trans. Roy. Inst. Technol., Stockholm, No. 177, 44p(1961).

An apparatus for measuring the range in liquids of α particles from radioisotopes is described. Its accuracy is about 0.1% for measurements of ranges of the order of 50 μ, e.g., for ^{210}Po α particles in hydrocarbons. With this accuracy in measurements, it was anticipated that chemical bond effects on the stopping power of α particles would be displayed for the first time, thus allowing these phenomena to be closely studied. Principles of the method used and the main points of design are sketched, and details concerning the theory, design, and operation of the apparatus are given. Some typical results and an estimation of the expected errors are also given. The method depends on the following principle: Of the 2 plane and parallel walls of a microcell, one constitutes the support of a thin α source and the other is a sensitive α detector. The liquid in which the range is to be measured is situated between the walls. Particles emitted within an angle θ = arc cos x/R to the normal of the cell walls reach the detector wall and are counted (x is the perpendicular distance between the walls and R the range of the α particles considered). Since the emission of the particles is isotropic in space, the fraction dN of the particles of range R counted at a particular wall distance x is $1/4\pi$ of the solid angle formed by the opening 2 θ. The mean range is obtained by extrapolating the straight part of the number–distance (R vs x) curve to its intersection with the x axis. (BBB)

40057 A NEW METHOD FOR RANGE MEASUREMENTS OF VERY HEAVY IONS USING COULOMB EXCITATION AND PERTURBED ANGULAR CORRELATION. Lehmann, L.; Spehl, H.; Wertz, N. (Univ., Freiburg i. B.). Nucl. Instrum. Methods, 55: 201-4(Sept. 1967).

A method is proposed for the measurement of range and range straggling of very heavy ions in any stopping material. The usual radiochemical detection is completely avoided. A range measurement of 0.8-MeV tungsten ions in copper was carried out in order to demonstrate the method. The measured range is in good agreement with the theory of Lindhard, Scharff and Schiott. (auth)

40058 CHARGED PARTICLE SLOWING-DOWN SPECTRA AND ENERGY-LOSS DISTRIBUTION RESULTING FROM FAST-NEUTRON IRRADIATION OF WATER. Faw, Richard E. (Kansas State Univ., Manhattan). Nucl. Sci. Eng., 29: 210-17(Aug. 1967).

Energy spectra have been computed for protons, alpha particles, and their secondary electrons slowing down in water irradiated by 14.6-MeV neutrons. Spectra for protons and alpha particles were based on continuous slowing down theory. Anisotropy of the proton-recoil reaction and elastic nuclear collisions of charged particles were found to have negligible influence on energy spectra and the energy-loss distribution. Partitioning of the neutron first-collision dose rate among the three particles was found to be very sensitive to the cutoff energy for production of secondary electrons. An analysis based on treatment of a collisional energy loss of less than 200 eV as localized energy dissipation along a particle track showed that localized electronic energy loss is distributed among protons, alpha particles, and their secondary electrons in the respective fractions 0.530, 0.112, and 0.358. (auth)

40059 SPATIAL DEPENDENCE OF SLOWING-DOWN TIMES FOR 14.1-MeV NEUTRONS IN WATER. Chen, Shee-Ming; Lidofsky, Leon J. (Columbia Univ., New York). Nucl. Sci. Eng., 29: 198-209(Aug. 1967).

From pulsed-neutron measurements, the most probable slowing down times of 14.1-MeV neutrons to 1.1 and 0.8 eV in water are found to be 1.55 ± 0.15 and 1.85 ± 0.15 μsec, using cadmium-shielded ^{6}LiI scintillators at distances 10 to 50 cm from the source. No spatial dependence can be found. Subsequent Monte Carlo study of 120,000 neutron cases not only confirms the experimental results, but also yields a more detailed space-energy-time neutron distribution as well as average slowing down times to various epithermal energies. (auth)

40060 SECONDARY-DOSE EQUIVALENT MODEL AND COMPARISON OF 160-MeV PROTON-INDUCED NEUTRON AND PROTON DOSE WITH A COMPREHENSIVE EXPERIMENT. Liley, Bobby; Duneer, Arthur G. Jr. (North American Aviation Inc., Downey, Calif.). Nucl. Sci. Eng., 29: 189-97(Aug. 1967).

A secondary-dose equivalent model for calculating secondary proton and neutron doses in arbitrary geometries is described. The random position of origin of the secondary-nucleon, primary-proton residual kinetic energy and secondary-nucleon kinetic energy, and survival weight at the point of generation of the secondary particles are determined by random sampling techniques. Results from this model are compared with the experiment of Maienschein and Blosser which measured the dose from a 160-MeV proton beam incident on an aluminum slab. The agreement is generally better than the state-of-the-art accuracy for secondary-dose calculations. (auth)

40061 SINGULAR DIFFERENCE APPROXIMATIONS FOR THE DISCRETE ORDINATE EQUATIONS IN X–Y GEOMETRY. Davis, J. A.; Hageman, L. A.; Kellogg, R. B. (Bettis Atomic Power Lab., West Mifflin, Pa.). Nucl. Sci. Eng., 29: 237-43 (Aug. 1967). (WAPD-T-1931).

Two well-known finite difference approximations to the discrete ordinate equations in x–y geometry are shown to lead to a singular system of equations for the case of reflecting boundary conditions. These difference schemes are the diamond approximation of Carlson, and the central difference approximation. Despite this singularity it is shown for the diamond scheme that a solution always exists and is, in some sense, unique. For the central difference scheme, however, it is shown that a solution need not, and in most cases will not, exist. (auth)

Solid-State Physics

Refer also to abstracts 39637, 40473, and 40719.

40062 (BNL-11648) CONVERGENT, BOUNDING, APPROXIMATION PROCEDURES WITH APPLICATIONS TO THE FERROMAGNETIC ISING MODEL. Baker, George A. Jr. (Brookhaven National Lab., Upton, N. Y.). [1965]. 9p. (CONF-670921-1). Dep. CFSTI.

From International Congress on Magnetism, Boston, Mass.

The Padé approximant method is generalized in such a way that converging upper and lower bounds can be established from the early power series coefficients for a wider class of functions than was previously possible. These procedures are proved to be applicable to many thermodynamic properties of the ferromagnetic Ising model and used thereon. Although nonbounding calculational procedures are shown to be satisfactory for most states of the system, certain pitfalls of those procedures are noted near the critical points. (auth)

40063 (BNL-11659) ENERGY LOSS TO ELECTRONS IN CRYSTAL LATTICES. Erginsoy, Cavid (Middle East Technical Univ., Ankara (Turkey)). Aug. 1967. 18p. (CONF-670924-2). Dep. CFSTI.

From International Conference on Solid State Physics Research with Accelerators, Upton, N. Y.

In a discussion of energy loss by charged particles passing through crystalline materials, a distinction is made between core electrons in the solid, whose spatial distribution is expected to follow rather closely that of the nuclei, and the conduction electrons that are rather uniformly distributed. Energy loss to the core electrons is analyzed in terms of an impact-parameter model, and the dependence of the core-electron excitation on the impact parameter is shown. An electron-gas approximation is used to describe energy loss to conduction or valence electrons. Use of this approximation to analyze the energy loss of channeled protons passing through Si gives good agreement with experiment. (A.G.W.)

40064 (COO-1105-131) ELECTRICAL CONDUCTIVITY AND THERMOLUMINESCENCE IN PURE LiF. Pearson, D.; Cameron, J. R. (Wisconsin Univ., Madison. Dept. of Physics). [1966]. 15p. Dep. CFSTI.

The thermoluminescence from many types of LiF exhibits a nonlinear dependence on exposure level. This nonlinearity becomes noticeable at different exposure levels in various types of LiF. Two obvious models for the supralinearity present themselves: the creation by radiation of additional traps or additional recombination centers in the crystal. Additional evidence in favor of the creation of traps is presented. (W.D.M.)

40065 (ORNL-P-3251) MOESSBAUER EXPERIMENTS WITH ^{61}Ni. Love, John C.; Czjzek, Gordon (Oak Ridge National Lab., Tenn.); Spijkerman, J. J.; Snediker, D. K. (National Bureau of Standards, Washington, D. C.). [1967]. Contract W-7405-eng-26. 12p. (CONF-670812-3). Dep. CFSTI.

From International Conference on Hyperfine Interactions, Pacific Grove, Calif.

Using the ^{61}Ni Moessbauer effect, the ratio of the magnetic moments of ^{61}Ni nuclei in the first excited state and the ground state was measured: $\mu(\frac{5}{2})/\mu(\frac{3}{2}) = -(0.559 \pm 0.012)$. Hyperfine fields at nickel nuclei in iron (241 ± 7 kG) and in a Ni(85%) Cr(15%) alloy (~15kG) are determined. Very approximate values for isomer shifts of some nickel alloys, NiF_2, and NiO are given. (auth)

40066 (SC-DC-67-1762) INHOMOGENEITIES IN THE RESISTIVITY OF SINGLE CRYSTAL CADMIUM SULFIDE. English, F. L.; Parsons, M. K. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. Contract AT(29-1)-789. 12p. (CONF-670922-1). Dep. CFSTI.

From International Conference on II-VI Semiconducting Compounds, Providence, R. I.

Electron mirror photomicrographs of the (0001) surface of single-crystal CdS delineated regions of markedly different resistivities when an electric field was applied normal to the c axis. The higher resistivity regions, prominent in the electron mirror photomicrographs, formed linear bands of various widths (approximately 1 to 20 microns) across the surface of the crystal. The electric fields associated with these bands were in many cases an order of magnitude greater than those calculated assuming a uniform resistivity. The bands of higher-resistivity material are thought to extend deep into the bulk of the crystal because of the large potential gradients associated with them. Polishing scratches are also observed both with and without the applied electric field and are easily distinguishable. Electron microprobe photomicrographs of the higher-resistivity bands seen with the electron mirror microscope show these bands to be of lower average Z and to have different electroluminescent properties than the surrounding crystal. Segregation of impurities or vacancies in the vicinity of dislocation arrays are cited as possible causes of the higher-resistivity bands observed with the electron mirror microscope and electron microprobe. (auth)

40067 (UCRL-70393) SHOCK-INDUCED DEMAGNETIZATION OF YIG. Shaner, J. W.; Royce, E. B. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 1, 1967. Contract W-7405-eng-48. 10p. (CONF-670921-2). Dep. CFSTI.

From International Congress on Magnetism, Boston, Mass.

Measurements were made of the shock-induced reduction in the component of the magnetization of polycrystalline YIG along the direction of an applied field. This reduction is induced by the passage of an explosively generated shock wave in a direction perpendicular to the applied field. The data indicate that the passage of the shock wave through the sample induces a uniaxial magnetic anisotropy in the material. This magnetic anisotropy arises from the stress anisotropy associated with the shock wave compression of a material having a nonzero yield strength. The induced magnetic anisotropy makes the shock propagation direction an easy direction of magnetization, and the observed reduction in the component of the magnetization along the applied field arises mainly from the rotation of the magnetization toward the easy direction. Experiments were performed at three bias fields, each at three widely spaced shock pressures. At 0.09 Mbar, the induced anisotropy energy may be described by a term in $\sin^2\theta$. The coefficient of this term is in agreement with the value estimated from the usual magnetoelastic coefficients. At 0.20 and 0.44 Mbar, the contribution from a term in $\sin^4\theta$ is observed to dominate that from the $\sin^2\theta$ term, and the coefficient of the $\sin^4\theta$ term increases several-fold over its low-pressure value. A possible origin of this increase is discussed. (auth)

40068 ELECTRON PARAMAGNETIC RESONANCE IN ELECTRON-IRRADIATED GERMANIUM. Trueblood, D. L. (Purdue Univ., Lafayette, Ind.). Phys. Rev., 161: 828-33 (Sept. 15, 1967).

Spin-resonance studies have been made in oxygen-free p-type germanium after bombardment by 4.5-MeV electrons. Samples were bombarded and stored at 77°K, and measurements were made at liquid-helium temperatures with a superheterodyne spectrometer operating at 9500 MHz. Essentially the same resonance spectra appeared in both undoped and gallium-doped germanium samples that initially had room-temperature resistivities in excess of 40 Ω cm. No resolved hyperfine spectra were observed. The predominant set of lines represents a spin-½ center, designated Ge-P1, whose g tensor has ⟨100⟩⟨011⟩ symmetry, with g[011] = 2.025, g[011] = 1.629, and g[100] = 1.732. The line width is 70 G. The production rate of the center is approximately 1.6 cm^{-1}. The defect exhibits some of the characteristics of a long-lived electron trap. The traps begin to empty, as evidenced by a gradual decrease in the resonance signal, when the sample is warmed above 77°K. At 135°K the traps empty in seconds. The resonance signal returns when the traps are repopulated by a short burst of ionizing irradiation at 77°K. When the sample is warmed above 220°K, the center loses its trapping property and is assumed to have disappeared or changed its form. An analysis of the g shift and the trapping behavior is not sufficient to give a definite microscopic model of the Ge-P1 center; however, the high degree of symmetry of the g tensor suggests that the structure of the defect is simple. (auth)

40069 EFFECTS OF LOW-TEMPERATURE ELECTRON IRRADIATION ON THE ELECTRICAL PROPERTIES OF UNDOPED GaSb. Thommen, K. (Atomics International, Canoga Park, Calif.). Contract AT(11-1)-Gen-8. Phys. Rev., 161: 769-78(Sept. 15, 1967).

Undoped GaSb was irradiated with 1.0-MeV electrons near liquid-helium temperature and at ≈80°K. The effect on the Hall coefficient and the electrical resistivity was measured between 15 and 300°K. "Impurity" conduction, resulting from radiation-produced defects, was observed at low temperatures. At higher temperatures, where the normal conduction mechanism is predominant, the experimental data are consistent with a model characterized by radiation-produced acceptors with levels 0.023 eV above the top of the valence band and completely ionized radiation-produced donors. Isochronal and isothermal annealing studies were performed in the temperature range 15 to 440°K. No recovery was observed below 110°K. Major recovery stages were found near 122, 163, 203, and 365°K. Their activation energies were measured as 0.31 ± 0.02, 0.48 ± 0.03, 0.57 ± 0.03, and 1.0 ± 0.1 eV, respectively. The recovery near 122°K obeyed first-order kinetics. No simple recovery kinetics were found for the other stages. (auth)

40070 IRRADIATION DAMAGE IN n-TYPE GERMANIUM AT 4.2°K. Callcott, T. A.; Mackay, J. W. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-125. Phys. Rev., 161: 698-710(Sept. 15, 1967).

The conductivity measured during the application of pulsed electric fields is used to monitor the damage introduced at 4.2°K by energetic electron irradiation of n-type germanium. Fields above 20 V/cm completely ionize the donor impurities. Radiation-induced defects deplete the electron population of the donors by introducing deeper acceptor levels. A sensitivity to defect concentrations of 10^{12} cm^{-3} is obtained in material containing about 10^{14} Sb impurities cm^{-3}. The introduction rates of various defects are studied as a function of irradiation energy. One type, previously identified as a close vacancy–interstitial pair, is removed (presumably by annihilation) in the order of minutes by annealing at 65°K. This defect accounts for 95% of the conductivity change produced by irradiation at 0.7 MeV, but only 50% of the change at 4.5 MeV. Evidently this is the primary defect requiring the least energy for its formation. A second type of primary defect is distinguished by the fact that it is present after annealing to 90°K. The dependence on bombardment energy of the introduction rate of this defect indicates that multiple displacements may be involved in its production, and therefore it may be a double vacancy. A third type of defect is observed only after large fluxes of low-energy electrons, and appears to be a secondary defect resulting from radiation-induced conversion of primary defects. This defect also remains after annealing to 90°K, but it has electrical properties very similar to those of the defect that anneals at 65°K. Trapping properties of the first and third defect types lead to the conclusion that both are capable of capturing two electrons in n-type germanium and are therefore double-acceptor centers. (auth)

40071 RECOVERY OF ELECTRON-IRRADIATED ALUMINUM AND ALUMINUM ALLOYS, I. STAGE I. Sosin, A. (North American Aviation Science Center, Thousand Oaks, Calif.); Garr, K. R. Contract AT(04-3)-701. Phys. Rev., 161: 664-72(Sept. 15, 1967).

The recovery in stage I of the increase in electrical resistivity due to electron bombardment of aluminum has been examined using a "ratio-plot" technique. The differences in annealing between two samples with either different pre-irradiation histories or varying irradiation conditions are emphasized by this technique. Using samples irradiated to different doses (i.e., different initial defect concentration), the temperature region of non-first-order processes is clearly delineated; this region encompasses free interstitial migration. Using samples with 0.1 at. % copper or zinc and comparing with pure aluminum, the suppression of recovery by impurity doping is shown to be consistent with previous doping studies. (auth)

40072 EFFECTS OF X IRRADIATION AT 78°K ON PLASTICALLY DEFORMED KI. Hersh, Herbert N.; Cocco, Anthony (Zenith Radio Corp., Chicago). Phys. Rev., 161: 834-41 (Sept. 15, 1967).

Imperfections were deliberately introduced into good crystals of KI, giving rise to a structure sensitivity to radiation not heretofore observed. After x irradiation at 78°K, energy is stored in the form of I_2^- and E centers. The E centers are electron centers produced as the only complements of the I_2^- centers. Absorption of light in the E band releases free electrons, which recombine with the I_2^- molecules giving rise to characteristic emission. The same emission occurs during x irradiation. Light-sum measurements show that the characteristic emission during x irradiation is reduced by 11% as compared to annealed crystals, because some of the absorbed energy is stored as E + I_2^- centers, later to be released as characteristic luminescence. The imperfections introduced into the KI crystal by the plastic deformation act as electron (rather than hole) traps. Lattice defects in KCl and KBr behave similarly. (auth)

40073 ANNEALING STUDIES OF IRRADIATED PLATINUM. Attardo, M. J.; Galligan, J. M. (Brookhaven National Lab.,

Upton, N. Y.). Phys. Rev., 161: 558-68(Sept. 15, 1967). (BNL-11196).

A field-ion microscope operated at 4.2°K has been used to study defects introduced into 99.9998% pure platinum by fast-neutron irradiation. Damaged or depleted zones have been identified and their concentration and size have been studied as a function of dose and annealing temperature. Direct observations indicate a distribution of zone sizes up to approximately 40 Å in diameter. The density of these zones is linear with dose in the range from 10^{16} to 10^{18} n/cm^2 (E > 1.45 MeV). Field-ion-microscope studies also reveal that upon annealing through stage-IV recovery, the small depleted zones (<15 Å) grow, causing an increase in the density of zones in the range between 15 and 30 Å. Simultaneously, the largest of the depleted zones present collapse to form dislocation loops lying on {110} planes. The remaining depleted zones are removed at temperatures corresponding to that of self-diffusion. Stage-III recovery in platinum has also been studied by examining specimens irradiated at temperatures above and below stage-III recovery. Direct observation indicates that some form of interstitial-atom motion must be associated with this recovery stage. The possibility of vacancies moving in this temperature range is specifically ruled out by energy considerations. (auth)

40074 NEW SCHEME FOR THE CONSTRUCTION OF PHASE SHIFTS WITH APPLICATION TO NUCLEAR MAGNETIC RESONANCE. Alfred, L. C. R.; Van Ostenburg, D. O. (Argonne National Lab., Ill.). Phys. Rev., 161: 569-70(Sept. 15, 1967).

A semiempirical scheme is developed for the construction of phase shifts of unlimited order for the investigation of properties depending on the electron redistribution in alloys. The method utilizes a generalized free-electron potential around the solute atom, residual-resistivity data, and the Friedel sum rule. Application to the Knight shifts in a series of dilute alloys with liquid copper and solid silver as hosts lead to much better agreement with experiment than obtained previously. (auth)

40075 REVERSIBILITY OF FAST-CHARGED-PARTICLE TRAJECTORIES IN SINGLE CRYSTALS. Bogh, E.; Whitton, J. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. Lett., 19: 553-5(Sept. 4, 1967).

Experiments to study the motion of fast charged particles in single crystals have been divided into two types, usually termed "channeling" and "blocking." Measurements of the Rutherford scattering yield in single crystals offer the possibility of studying channeling and blocking in one experiment A description is given of how such an experiment has been used to demonstrate Lindhard's "rule of reversibility." (J.H.M.)

40076 DECREASE OF MOESSBAUER RECOIL-FREE FRACTION IN SMALL TUNGSTEN PARTICLES. Roth, S.; Hoerl, E. M. (Oesterreichische Studiengesellschaft fuer Atomenergie, Seibersdorf, Austria). Phys. Lett., 25A: 299-300(Aug. 28, 1967).

The Debye–Waller factor of tungsten microcrystals has been investigated by the Moessbauer technique and found to decrease with particle size. The results are discussed in terms of the Debye model as well as in terms of a modified Debye model. (auth)

40077 INELASTIC CRITICAL SCATTERING OF NEUTRONS FROM TERBIUM. Als-Nielsen, J. (Research Establishment, Risoe, Denmark); Dietrich, O. W.; Marshall, W.; Lindgard, P. A. Solid State Commun., 5: 607-11(Aug. 1967).

The inelasticity of the critical neutron scattering in Tb above the Néel temperature was measured. The results show that dynamical slowing down of fluctuations occurs at a second order phase transition. (auth) (UK)

40078 ANALYSIS OF X-RAY AND NEUTRON DIFFRACTED INTENSITIES CALCULATED FOR A RANDOM NETWORK MODEL OF VITREOUS SILICA. King, S. V. (Birkbeck Coll., London). Nature (London), 215: 615-17(Aug. 5, 1967).

Diffraction patterns of vitreous silica are characterised by low density at the centre and a small number of diffuse maxima at small angles, indicating that only short-range order exists. This leads to two different interpretations of structure: (a) that it consists of an irregular noncrystalline network of Si and O atoms, (b) that it consists of an aggregate of extremely small crystals. The present communication describes preliminary results of calculations of x-ray- and neutron-diffraction intensities from an irregular noncrystalline network model of the material. X-ray data are plotted for components of the coherent intensity as calculated for silicon pairs, oxygen pairs, and silicon–oxygen pairs. There are clear indications that each type of interaction contributes significantly to the total scattering throughout the whole pattern. Data are also plotted for neutron diffracted intensities. The calculated scattering curves agree quite well with experimental curves. (UK)

40079 MECHANISM OF THE LOW-TEMPERATURE DECREASE OF RADIOLUMINESCENCE YIELD. Aluker, E. D.; Mezina, I. P. Opt. Spectrosc. (USSR) (Engl. Transl.), 22: 428-9(May 1967).

Translated from Opt. Spektrosk., 22: 788-91(May 1967).

The decrease in activator radioluminescence yield at low temperatures is associated with recombination of holes at electronic activator color centers (of the Tl^0 type). It is shown that this mechanism is in good agreement with the data on the temperature dependence of x-ray luminescence spectra. (auth)

40080 EXCITATION CROSS SECTIONS OF LOWER LEVELS OF LITHIUM. Aleksakhin, I. S.; Zapesochnyi, I. P. Opt. Spectrosc. (USSR) (Engl. Transl.), 22: 458-9(May 1967).

Translated from Opt. Spektrosk., 22: 843-4(May 1967).

Results are presented on the determination of the absolute cross sections for the excitation of the ground-state levels of the lithium atom by slow electrons. The experimental setup comprised a metallic collision chamber with intersecting atomic and electron beams and a device for measuring the density of the atomic beam. (M.H.R.)

40081 INELASTIC TRANSITIONS BETWEEN THE FINE STRUCTURE COMPONENTS OF ALKALI METAL ATOMS IN CASE OF ADIABATIC COLLISIONS. I. GENERAL THEORY. Nikitin, E. E. Opt. Spectrosc. (USSR) (Engl. Transl.), 22: 379-84(May 1967).

Translated from Opt. Spektrosk., 22: 689-98(May 1967).

A general method of calculating cross sections for transitions between the fine structure components of atoms in ^2P_j states undergoing collisions is given. It is assumed that the characteristic parameter of the problem, $\Delta\epsilon/\hbar\alpha v$ (where $\Delta\epsilon$ is the energy of the transition, α is the exponential parameter characterizing the exchange interaction, and v is the velocity of the colliding partners) is larger than unity, i.e., that the collisions are adiabatic. In this approsimation quantum corrections to the classical expressions for the cross sections are determined. (auth)

40082 PHOTOCONDUCTIVITY AND QUANTUM YIELD IN GERMANIUM EXPOSED TO PULSED X RADIATION. Kamoldinov, M. G. (Yakutsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 22-6(1967). (In Russian).

An investigation was made of the photoconductivity in germanium stimulated by short-duration "pulsed" x radiation. It was assumed that only volume ionization was present in the specimens. All measurements were carried out at room temperature. Heating of the crystals by incoming radiation was ignored. It was found that photoconductivity in the pulsed irradiation mode is very low. The specimen's resistance changed by only several hundredths of a percent from the initial. The quantum yield of the photoconductivity in the pulsed mode is high. The x-ray pulse causes an intensive collision ionization in the crystal, producing a large quantity of electron–hole pairs. In addition, the destruction of traps is stimulated. Competing ionization processes during pulse duration are practically nonexistent. As a result, a temporarily exaggerated quantum yield β_u is obtained. The germanium photoconductivity in the stationary x-radiation mode is considerably higher at smaller quantum yield β_{stat}. The large quantum yield in a pulsed mode is not simply the result of the high intensity of beam in the pulse. β_u is assumed to be the true quantum yield in the pulsed mode. (ATD)

40083 PHOTOCONDUCTIVITY OF SILICON IN THE X-RAY REGION. Kamoldinov, M. G. (Yakutsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 27-31(1967). (In Russian).

Measurements of the photoconductivity of silicon were made, using a bridge scheme with symmetry of the type $R_1 = R_3$, $R_2 = R_4$. The μ_{eff} coefficient was measured by irradiating the silicon specimens with x-ray doses maintained within the linear range of the sensitometric curve of the x-ray film. A table compares the theoretical and experimental values of μ for three wavelengths: 0.248, 0.165, and 0.062 Å. The sensitivity of silicon single crystals as a function of absorbed x-ray power is shown graphically for the same wavelengths. (ATD)

40084 THREE-PHONON PROCESSES IN SOLID HELIUM CRYSTALS. Ackerman, C. C.; Guyer, R. A. (Duke Univ., Durham, N. C.). Solid State Commun., 5: 671-5(Aug. 1967).

Poiseuille flow data and second sound data on solid helium crystals are analyzed to find the normal-process scattering rate. (auth) (UK)

40085 ENERGY LOSS AND RANGE OF FISSION FRAGMENTS IN SOLID MEDIA. Cumming, J. B.; Crespo, V. P. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 161: 287-93(Sept. 10, 1967). (BNL-11242).

Energy losses and ranges in Mylar have been measured for some representative fission fragments; these data and existing

stopping-power measurements for bromine and iodine ions in media from carbon to gold are shown to be consistent with a semiempirical theory that treats electronic stopping processes in terms of an effective charge Z_1^*, which depends on the velocity of the ion. The fractional effective charge Z_1^*/Z_1 is shown to be a universal function of the variable $v/v_0Z_1^{\frac{1}{2}}$, where v_0 is the Bohr velocity and Z_1 is the nuclear charge of the fragment. This semiempirical treatment, when combined with existing theoretical estimates for nuclear stopping powers, correctly predicts ranges of fission-fragment-like ions. (auth)

40086 NUCLEAR MAGNETIC RESONANCE AND MAGNETIC SUSCEPTIBILITY OF $SmAl_3$. de Wijn, H. W. (Univ., Amsterdam); van Diepen, A. M.; Buschow, K. H. J. Phys. Rev., 161: 253-7(Sept, 10, 1967).

The Knight shift of the ^{27}Al NMR in $SmAl_3$ has been measured in the temperature region from 78 to 400°K, and the susceptibility of $SmAl_3$ has been measured up to 850°K. The part of the Knight shift arising from polarization of the conduction electrons through exchange with the 4f electrons reverses sign at (310 ± 20)°K, and the relation between the Knight shift and the susceptibility is not linear. This behavior results mainly from Van Vleck-type paramagnetism, and could adequately be calculated on the basis of free Sm^{3+} ions. The parameters used are the multiplet splitting constant $A/k = (410 \pm 20)$°K, and the interionic exchange constant $\mathfrak{J}_{ff}/k = -(15 \pm 5)$°K, indicating antiferromagnetic ordering at low temperatures. The effective exchange constant between the conduction-electron spins and the 4f-electron spins has been found to be $\mathfrak{J}_{sf} = -0.21$ eV, equaling those derived for other RAl_3 compounds (R = rare earth). The nuclear quadrupole coupling has been measured to be $|e^2qQ|/h = (0.8 \pm 0.1)$ Mc, and is discussed in terms of the point-charge model. (auth)

40087 NUCLEAR MAGNETIC RESONANCE IN BERYLLIUM. Anderson, W. T. Jr.; Ruhlig, M.; Hewitt, R. R. (Univ. of California, Riverside). Phys. Rev., 161: 293-4(Sept. 10, 1967).

NMR of ^9Be in beryllium metal powder has been measured from 5 to 20 kG at 295°K. The isotropic Knight shift is measured as $(-0.0027 \pm 0.0006)\%$; the anisotropic Knight shift $|a| < 0.0003\%$; and the quadrupole coupling e^2qQ/h is measured as 56.4 ± 0.3 kc. (auth)

40088 CHANNELING EFFECTS IN THE ENERGY LOSS OF 3 TO 11-MeV PROTONS IN SILICON AND GERMANIUM SINGLE CRYSTALS. Appleton, B. R. (Bell Telephone Labs., Murray Hill, N. J. Rutgers-The State Univ., New Brunswick, N. J.); Erginsoy, C.; Gibson, W. M. Phys. Rev., 161: 330-49(Sept. 10, 1967). (BNL-11207).

Planar and axial channeling effects of 3- to 11-MeV protons in 25- to 50-μ-thick silicon and germanium single crystals were investigated by studying the direction and energy distributions of the transmitted particles. The total energy distributions were investigated as a function of crystal orientation using a large-acceptance-angle solid-state detector. Limiting angles of incidence for channeling were obtained at several incident energies and crystal thicknesses. The energy and intensity as a function of emergence angles (for a fixed angle of incidence) were obtained by scanning the emergent proton distributions with a small-acceptance-angle detector ($75. \times 10^{-7}$ sterad) or a masked lithium-drifted position-sensitive detector in a plane 102 cm from the crystal. The least energy loss for protons transmitted parallel to the ⟨110⟩ and ⟨111⟩ axes and the {111}, {110}, and {100} planes of silicon were investigated, and it was found that the least energy loss for each axis was the same as that of the most open planes intersecting at that axis. Measurements of the least energy loss and its straggling were made for the {111} and {110} planes of silicon and germanium. A mechanism of least energy loss is presented for which it is assumed that the energy loss of the well-channeled protons is due to interactions with the weakly bound valence electrons only. The measurements agree well with the theory and are used to extract the local density of valence electrons sampled by the well-channeled protons. A theoretical model of channeling is presented and comparisons made with experiment. Average potentials for the atom rows and planes of silicon are calculated for the static lattice at different temperatures. Multiple Coulomb scattering into channels is considered, as well as the trajectories of the high-loss particles. (auth)

40089 MAGNETIC FORM FACTOR OF TERBIUM. Steinsvoll, O. (Brookhaven National Lab., Upton, N. Y.); Shirane, G.; Nathans, R.; Blume, M.; Alperin, H. A.; Pickart, S. J. Contract AT(30-2)-Gen-12. Phys. Rev., 161: 499-506(Sept. 10, 1967). (BNL-11132).

The magnetic form factor of Tb at 4.2°K has been measured to $(\sin\theta)/\lambda = 1.1$ Å^{-1} by the use of both polarized and unpolarized neutrons. The crystal was magnetized along the b and a directions by the use of a split-coil superconducting magnet providing a field of 40 kOe. At lower scattering angles where the magnetic amplitude p is greater than the nuclear amplitude b, the main source of experimental error is uncertainty in the extinction correction, which was estimated by changing wavelength as well as sample thickness. At higher scattering angles where $p < b$, the polarized-beam experiments yielded accurate form-factor values. Except for a scale factor, the measurements are in good agreement with theoretical values, suggesting a contribution from the conduction electrons borne out by Fourier synthesis of the magnetization density. A theoretical calculation has been made of the aspherical contribution to the form factor. (auth)

40090 RANGE MEASUREMENTS IN ORIENTED TUNGSTEN SINGLE CRYSTALS (0.1–1.0 MeV). II. A DETAILED STUDY OF THE CHANNELING OF ^{42}K IONS. Eriksson, L. (Univ of Aarhus, Denmark). Phys. Rev., 161: 235-44(Sept. 10, 1967).

The mechanism of channeling of ^{42}K ions in monocrystalline tungsten is investigated. The influence of various parameters — ion energy, crystal direction, surface oxide thickness, misorientation, lattice temperature, and bombardment dose — has been studied. It is found that: (i) the overall range distribution is rather sensitive to all these parameters; (ii) the maximum range R_{max} depends only on the ion energy and crystal direction; (iii) planar channeling exists down to the lowest energy studied (70 keV); (iv) the critical angle for channeling is about 3° at 500 keV and decreases slowly with increasing energy. In all cases, the crystals have been oriented with respect to the ion beam to ±0.1°, by means of wide-angle scattering of protons. An attempt is made to correlate the results for these fairly slow heavy ions with Lindhard's theoretical treatment of the motion of charged particles in a crystal lattice, and with the experimental studies on fast light ions. (auth)

40091 CHANNELING IN DIAMOND-TYPE AND ZINC-BLENDE LATTICES: COMPARATIVE EFFECTS IN CHANNELING OF PROTONS AND DEUTERONS IN Ge, GaAs, AND Si. Sattler Allan R. (Sandia Lab., Albuquerque, N. Mex.); Dearnaley, G. Contract W-7405-eng-36. Phys. Rev., 161: 244-52(Sept. 10, 1967). (LA-DC-8665).

The energy losses of ions channeled through GaAs, Ge, and Si were compared. The average number of electrons per atom participating in the stopping of channeled particles is about the same for elemental Ge and partially ionic GaAs. The number of electrons per atom participating in the stopping of channeled hydrogen ions is less for Si than for Ge or GaAs. Axial and planar channeling are discussed. The energy losses of axial channeling appear to be characterized by the energy losses of the plane having the largest interplanar spacing in the axial intersection. A much larger fraction of the incident beam undergoes channeling when the beam is incident along an axial intersection than when the beam is along a plane of the intersection. Comparison of energy losses of H^+ and D^+ shows that the mass dependencies of the minimum energy losses in channeling can be correlated simply with a velocity-dependent function. Velocity is, therefore, the important parameter in the slowing down of channeled ions within a given host lattice. The analyses of the data give evidence that an equation of the same form as the Bethe equation accounts for the minimum energy losses of channeled particles. (auth)

40092 RANGE MEASUREMENTS IN ORIENTED TUNGSTEN SINGLE CRYSTALS (0.1–1.0 MeV). I. ELECTRONIC AND NUCLEAR STOPPING POWERS. Eriksson, L; Davies, J. A.; Jespersgaard, P. (Univ. of Aarhus, Denmark). Phys. Rev., 161: 219-34(Sept. 10, 1967).

Range distributions of ^{24}Na, ^{32}P, ^{42}K, ^{51}Cr, ^{64}Cu, ^{82}Br, ^{85}Kr, ^{86}Rb, ^{122}Sb, ^{125}Xe, ^{133}Xe, ^{187}W, and ^{222}Rn ions in the energy region 0.1 to 1.0 MeV have been measured in oriented tungsten single crystals by means of the electrochemical peeling technique. Wide-angle scattering of protons has, in some cases, been used to align the crystals to within ±0.1°. The range distributions consist of two peaks — a broad one at approximately the depth predicted for an amorphous target, and a sharp one at a much larger depth. The latter, caused by channeling, falls off very sharply on the more penetrating side. This well-defined maximum range has approximately an $E^{\frac{1}{2}}$ dependence, characteristic of electronic stopping. From range–energy relations, electronic-stopping cross sections are derived at a constant velocity of 1.5×10^8 cm/sec. The electronic stopping is roughly $\frac{1}{3}$ of that predicted for amorphous tungsten, but exhibits a strongly oscillating dependence on Z_1. These Z_1 oscillations are much larger than those reported previously in amorphous foils. The range dispersion between the ⟨100⟩ and ⟨110⟩ directions exhibits an oscillating Z_1 dependence. For perfectly channeled Xe ions along the ⟨100⟩ directions, electronic stopping is shown to dominate down to a few keV. The contributions from nuclear and electronic stopping become equal at about 4 keV, whereas the corresponding

transition energy in amorphous tungsten would be ~2.5 MeV. The nuclear stopping contribution can be fitted theoretically by means of the momentum approximation down to ~0.5 keV. It is shown that, under certain conditions, range measurements in monocrystals provide information about amorphous ranges that is otherwise difficult to obtain. Good agreement between experiments and theoretical predictions is obtained. Some information is provided on the highly penetrating tail (supertail), earlier reported in tungsten. For comparison, a few range distributions have been measured in aluminum single crystals. The observed behavior is similar to that in tungsten, but the channeling is much less pronounced. (auth)

40093 EFFECT OF TRAPPED LUMINESCENCE LEVELS DURING CdS SINGLE CRYSTAL EXCITATION BY X RADIATION. Korsunskaya, N. E.; Svechnikov, S. V.; Chalaya, V. G. (Inst. of Semiconductors, Kiev). Ukr. Fiz. Zh., 12: 874-5(May 1967). (In Russian).

High-ohm, photosensitive single crystals of CdS with dimensions of 1 × 1 × 0.1 mm were synthesized from the vapor phase, and were excited with light or x rays in the dark at liquid nitrogen temperature. The samples were fitted with electrodes of fused indium or sputtered cadmium. After irradiation the samples were heated at 0.4°C/sec with a voltage of 5 volts applied to the electrodes. A thermally stimulated emission took place at about 140°C. The concentration of trapped electrons was calculated to be 10^{15} cm^{-3} for excitation with x rays. The difference in the degree of filling of the trapping centers is due to the difference in level ionization by fast electrons occurring as a result of the absorption of high-energy quanta. (TTT)

40094 DIELECTRIC AND OPTICAL ABSORPTION MEASUREMENTS ON CaF_2 AND CaF_2:Y. Caffyn, J. E.; Goodfellow, T. L.; Olymbios, E. M.; Perrin, D. J. (City Univ., London). Phys. Status Solidi, 22: 549-57(1967).

Crystals of oxygen-free and oxygen-contaminated CaF_2 were doped with yttrium. The dielectric loss of the unirradiated crystals was measured at 150 °C at different frequencies and a shift of the peak in the curves was found with varying concentration of yttrium. In oxygen-free crystals the peak was displaced to higher frequencies while with oxygen contaminated crystals the shift was to lower frequencies. The optical absorption spectra were taken at room temperature before and after room temperature x irradiation. The uv optical absorption that exists in oxygen-contaminated crystals even before x irradiation was found to decrease in yttrium-doped crystals grown from oxygen-contaminated material. It is proposed that the observed results could be explained on the assumption that one or more of the following associated defects are present in the crystals, namely: (1) an oxygen ion and fluorine ion vacancy, (2) an yttrium ion and an interstitial fluorine ion, and (3) an yttrium ion and a substitutional oxygen ion. The shift of the dielectric loss peak to lower frequencies for yttrium-doped oxygen contaminated crystals is correlated with the reduction of the uv optical absorption. It is suggested that possible explanation for this reduction is due to the formation of yttrium–oxygen dipoles. Thermal annealing of these crystals provides further confirmation of this suggestion. (auth)

40095 INTERACTION OF RADIATION WITH SOLIDS. Proceedings of the Cairo Solid State Conference at The American University in Cairo, held September 3–8, 1966. Bishay, Adli (ed.). New York, Plenum Press, 1967. 708p. $20.00. (CONF-660923).

Forty-six papers are included under the following section headings: magnetic resonance, electrical conductivity, radiation effects on noncrystalline solids, radiation effects on crystalline solids, metals, spectroscopy, and quantum electronics. Separate abstracts were prepared for twenty-five papers. Abstracts of two papers have previously appeared in NSA as numbers 20: 44991 and 46223. (A.G.W.)

For abstracts of individual papers see: 39153 and 40096–40119.

40096 RADIATION DAMAGE STUDIES OF LIBYAN DESERT SILICA GLASS. Bishay, A.; Hassan, F. (American Univ., Cairo). pp 95-106 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

The EPR spectrum for a number of Libyan Desert silica glass samples was studied before and after reactor and cobalt-60 irradiation. A resonance line at about g = 4.2660 was observed in the unirradiated samples; it increased in intensity with increasing total iron content. This line was attributed to Fe^{3+} ions since Fe^{3+} does not give any EPR spectrum at temperatures above the liquid hydrogen range. Irradiation of different samples resulted in decreasing the intensity of the 4.2660 line and increasing the intensity of the optical absorption band at 1.8 microns, which is characteristic for four-coordinated ferrous ions. A broad resonance was also observed at about g = 2 in the unirradiated sample. This resonance was not observed in the same sample after heating for 30 minutes at 500°C, which indicated that it was mainly due to solarization effects. These observations support the postulate that the g = 4.2660 line corresponds to Fe^{3+} iron in 4-coordinated positions and that practically all the ferric ions in Libyan Desert silica glass enter the silica network substitutionally for silicon. Ferrous ions take both four- and six-coordinated positions. A sharp resonance at about g = 2.0005 was observed in irradiated samples and attributed to the E′ center reported by Weeks in pure quartz and pure silica. This resonance was much stronger in reactor-irradiated samples than in those irradiated with cobalt 60. It was noted that splitting became more apparent as a result of fading. Furthermore, the intensity of the resonance in this range increased with increasing iron content, which indicated that, in addition to the E′ center, a ferric defect center contributes to this resonance. A broad resonance was observed in the region of g = 2.009 and was attributed to the well known aluminum center. (auth)

40097 RADIATION EFFECTS IN SEMICONDUCTORS. Crawford, James H. Jr. (Oak Ridge National Lab., Tenn.). pp 107-32 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

Although radiation damage in elemental semiconductors and its consequences for a variety of electronic properties have been intensively investigated for the past 20 years, appreciable progress in understanding the nature of the resultant lattice imperfections has been achieved only since electron spin resonance experiments have established that stable defects in irradiated silicon for the most part consist of complexes involving point defects and impurity atoms. Positive identification has been made of oxygen–vacancy complexes, donor–vacancy complexes, acceptor–vacancies, divacancies, and interstitial impurity atoms. Except for the divacancies, which are a direct product of the irradiation, the complexes are created when point defects (vacancies and interstitials) move through the lattice and interact with impurities. Although equally definitive ESR data are not yet available for germanium, much of the impurity-sensitive response in this material can be understood on the basis of analogous impurity–defect interaction processes demonstrated for silicon. The points of evidence pertaining both to the identification of radiation defects in silicon and germanium and to their electronic behavior are summarized, and inferences from these studies for other semiconductor systems and the radiation sensitivity of devices are drawn. (46 references) (auth)

40098 THE INFLUENCE OF NEUTRON IRRADIATION ON THE THERMOELECTRIC POWER AND THE ELECTRICAL CONDUCTIVITY OF NEARLY STOICHIOMETRIC SINGLE CRYSTALS OF URANIUM DIOXIDE. De Coninck, R.; Devreese, J.; Nagels, P. (SCK–CEN, Mol, Belg.). pp 187-98 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

Nearly stoichiometric uranium dioxide single crystals have been irradiated by different doses of thermal neutrons. Before and after irradiation, the electrical conductivity (σ) and the thermoelectric power (S) were measured as a function of temperature. The effect of a small dose on S is most pronounced at low temperatures, while a larger dose also causes a decrease of S at higher temperatures. The electrical conductivity also decreases upon neutron irradiation and its activation energy increases. These effects on the electrical conductivity were observed earlier and attributed to a decrease in the number of holes (p) in UO_{2+x}. However, a decrease in p only would imply an increase of S, whereas a decrease was observed. Therefore, it was necessary to introduce a further assumption. The bending of the $\ln \sigma T^{\frac{1}{2}}$ versus 1/T curves at low temperature suggests the possibility of n-type impurity conduction. This hypothesis could not be confirmed from thermoelectric power measurements on unirradiated crystals because of experimental difficulties. However, it was supported by an analysis of S_t and σ as functions of temperature after neutron irradiation. A maximum in S_t appears after irradiation. This maximum shifts to higher temperatures with increasing dose because the irradiation causes an increase in the number of compensating donors (hole-traps) and so enhances the effect of the impurity conduction. (auth)

40099 RADIATION EFFECTS ON COMPLEX GLASSES. Lell, E.; Kreidl, N. J. (Univ. of Missouri, Rolla). pp 199-212 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

While the complexity and specificity of radiation-induced centers in complex glasses is not surprising because of the variability in the environment in vitreous substances, it has become increasingly possible to characterize several centers in a manner to elucidate principles of structures and radiation effects. The role of nonbridging oxygen and of the systematic variation of alkali near these oxygens in electron trap centers as well as a series of specific centers around technologically important additives is now capable of reasonable interpretation. Special reference is given to the different centers induced in phosphate glasses containing silver. (auth)

40100 GAMMA INDUCED COLORATION IN RELATION TO STRUCTURAL CHANGES IN GLASS. Bishay, Adli (American Univ., Cairo); Maklad, M.; Gomaa, I.; Arafa, S. pp 213-35 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

A number of examples are presented in which induced coloration resulting from the interaction of high-energy radiation with different glasses can be used to detect structural changes. Infrared-absorption and x-ray-diffraction studies of the same glasses are used to confirm these structural changes. The changes in the intensity of the 1.6- and 2.4-eV bands induced in lead borate glasses suggested structural changes at compositions containing about 25, 33, and 45 mole % PbO. These changes were confirmed by x-ray-diffraction studies of the heat-treated devitrified samples, which showed the appearance or disappearance of certain lead borate compounds at these compositions. Infrared absorption studies of the glass samples of this series showed maxima in the intensity of the BO_4/PbO_x bands at the above-mentioned compositions. Similar studies were made on arsenic borate and barium silicate glasses. The changes in As^{5+}/As^{3+} as well as the changes in the role of arsenic and boron in structure were indicated in the induced absorption and confirmed by other physical properties. Barium silicate glasses showed changes at 22.5 and 27.5 mole % BaO in the induced optical absorption and infrared absorption spectra. This was confirmed by changes in the x-ray-diffraction patterns of the heat-treated devitrified samples of the same series. (auth)

40101 GAMMA RADIATION INDUCED OPTICAL ABSORPTION IN LEAD BORATE GLASSES. Barker, R. S. (Pilkington Brothers Ltd., Lathom, Eng.). pp 237-49 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

The gamma-radiation-induced absorption spectra between 3.45 and 0.81 eV in lead borate glasses containing between 36% and 64% molar lead oxide have been measured after radiation doses up to 10^8 rads. The spectra have been resolved into three Gaussian-shaped absorption bands centered at 1.61, 2.40, and 3.28 eV. For each glass the variation in intensity of each band with radiation dose consists of a saturating component and a linear component. After any given dose, the intensity of the 2.40-eV band decreases continuously with increasing lead content, but the intensity of the 3.28-eV band passes through a minimum corresponding to about 55% molar PbO. (auth)

40102 RADIATION EFFECTS IN GLASS LASERS. Tittel, F.; Kamel, N. (American Univ., Cairo). pp 261-72 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

Experiments are in progress to study the effects of gamma irradiation on the stimulated emission properties of laser glasses. The effects of high-energy radiation upon glass are complex. The two principal processes are ionization (leading to color or defect-center formation) and displacement of atoms from their position in the lattice. Of particular interest are induced optical absorption effects in commercially available laser glasses of different composition and dopant ions, starting with neodymium-doped silicate glass (Eastman Kodak ND 11). Such changes as light absorption in glass produced by ionizing radiation may improve the optical efficiency for a laser by increased effective coupling between an optical pump source and the active medium. Improved laser efficiency was reported for irradiated crystal systems. However, a degradation of laser performance may also occur depending on the glass network and modifier composition, especially when metallic ion impurities (lead, iron, zinc) are present. The effect of dose rate, total dose, selective bleaching, and temperature will be related to optical absorption and emission measurements, laser tests, optical quality, and magnetic resonance studies. Comparison with both a nonirradiated and an undoped laser glass sample will be made. (auth)

40103 THERMOLUMINESCENCE AND COLOR CENTERS IN SOME IRRADIATED VITREOUS AND CRYSTALLINE SILICATES, BORATES, AND PHOSPHATES. Bettinali, C. (CNEN, Rome. Univ., Rome). pp 273-80 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

The thermoluminescence and the absorption spectra of some glasses and their devitrification products in the system Li_2O–SiO_2, Na_2O–B_2O_3, and Na_2O–P_2O_5 were studied. The activation energies and the thermoluminescence spectra were studied either in glasses or in devitrified systems from the glow-curves. The color centers were investigated by obtaining the absorption spectra and the ESR spectra. The thermoluminescence shows a different behavior in the different systems. In the silicate glasses, the devitrification modifies the intensity and the temperature of the low-temperature peak. The glow peaks at 80 and 220°C are strongly increased by a 10^4 factor. In the phosphate glasses, the low-temperature peak is modified as in the silicate glasses, but the high-temperature thermoluminescence does not change in intensity from the vitreous to the crystalline form. The vitreous sodium borates show a similar behavior. The relation between the thermoluminescence and the color centers is different in the crystalline and vitreous products. The mechanisms of the thermoluminescence and the color center formation are discussed. (auth)

40104 THERMOLUMINESCENCE OF VITREOUS SODIUM ALUMINO SILICATES AND GERMANATES. Bettinali, C.; Gottardi, V.; Ferraresso, G. (Univ. Cattolica, Rome. Stazione Sperimentale del Vetro, Murano, Italy). pp 281-6 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

The correlation between color centers and thermoluminescence was studied in gamma-irradiated glasses of the Na_2O–Al_2O_3–SiO_2 and Na_2O–Al_2O_3–GeO_2 systems. The perturbing effect of increasing Al content on the thermoluminescence activation energies was investigated. The activation energy values obtained from the glow-curves analysis agree with the values calculated, assuming, for the electron trap, a hydrogenoid model. The absorption spectra of the samples containing $Al/Na > 1$ and $Al/Na < 1$ were also investigated and compared to the thermoluminescence spectra. The thermoluminescence between 20 and 300°C is related to electron–hole recombination. (auth)

40105 THERMOLUMINESCENT GLASS ACTIVATED BY MANGANESE. Kocik, J.; Nebrensky, J. (State Glass Research Inst., Hradec Kralove, Czechoslovakia). pp 287-303 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

The use of glass for the dosimetry of ionizing radiation can be substantially based on one of the three following phenomena: radiocoloration (change of the spectral absorption), radiophotoluminescence effect, or radiothermoluminescence effect. The influence of different factors on the resulting thermoluminescent properties of phosphate glasses activated by manganese was studied. The following items are considered: the content of various impurities in the glass, the concentration of the activator, the chemical composition of base glass, the effect of the Al_2O_3–P_2O_5 substitution, and the effect of Li_2O content in the glass. In the case of phosphate glasses activated by manganese it is possible to achieve promising properties for their use as thermoluminescent phosphors for dosimetry purposes. The glow curve is well defined with one maximum around 300°C, the dose response is nearly linear, and the emission spectrum is favorable. (auth)

40106 PROBLEMS IN THE IRRADIATION OF POLYMERS. Charlesby, A. (Royal Military Coll. of Science, Shrivenham, Eng.). pp 305-17 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

The study of radiation effects in polymers has wide ramifications, ranging from the basic phenomena of interaction of radiation and matter, radiation physics, and chemistry to industrial applications and radiobiology. Early observations on crosslinking and degradation of simple polymers have been subjected to further and more detailed study using such techniques as electron spin resonance, optical absorption, pulse radiolysis and thermoluminescent spectroscopy to determine the intermediate processes. The

influence of crystal structure, of molecular mobility in solution, and of additives present in very small concentration, have all been analysed. A long sequence of events appears to be involved from the initial absorption of energy to the final physical and chemical change. (auth)

40107 MECHANISM OF THE TRANSFORMATION OF CRYSTALLINE QUARTZ INTO AMORPHOUS SILICA BY NEUTRON IRRADIATION. Comes, R.; Lambert, M.; Guinier, A. (Univ., Paris). pp 319-39 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

A single crystal of quartz becomes amorphous after a strong irradiation (dose >10^{20} n/cm^2), its structure being very similar to that of vitreous silica. The structure of intermediate stages, corresponding to increasing neutron doses, was studied in order to follow the transformations. In the first (<2×10^{19} n/cm^2), the defects are homogeneously dispersed through the crystalline lattice giving a normal diffraction pattern, but the lattice parameters are increased and the macroscopic dimensions of the crystal vary in the same direction. When the dose of neutrons increases, the structure of the quartz is no longer homogeneous; islands of highly perturbed matter are imbedded in a still-crystalline matrix. The proportion of the two phases may be evaluated by the measurement of the intensities of the crystalline reflections. The discrepancies between the variations of lattice parameters and macroscopic dimensions are quantitatively explained. The disordered phase for intermediate stages is not quite isotropic; it keeps some relation with the parent crystal structure. This is apparent in the diffraction pattern, which is not yet the simple ring pattern of the amorphous silica. On the other hand, the crystalline matrix is somewhat disturbed. The diffraction lines are broadened and an easily detectable characteristic diffuse scattering appears. This scattering is localized on the (101) and (100) planes of the reciprocal lattice and seems similar to the scattering observed in unirradiated quartz at a temperature very near the $\alpha \rightleftharpoons \beta$ transformation point. It can be interpreted by very numerous micro Dauphine twins. Above 6×10^{19} n/cm^2, the crystal has a hexagonal symmetry. This explains the disappearance of the $\alpha \rightleftharpoons \beta$ transformation by neutron irradiation. (auth)

40108 STRING EFFECT AND ITS USE IN SOLID STATE INVESTIGATIONS. Bogh, E. (Univ., Aarhus, Denmark). pp 361-72 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

The influence of crystal lattice periodicity on the motion of energetic, heavy charged particles penetrating a crystal is discussed. A short summary of Lindhard's theory and of the experimental information obtained in measurements of Rutherford scattering yields in single crystals is given. In the scattering experiments, a very marked decrease (between a factor of 10 and a factor of 100) in scattering yield is found whenever the particle beam is aligned within a certain critical angle of a major crystal axis. The critical angles obtained from the experiments are all in good agreement with theoretical estimates. A strong reduction in multiple scattering of the aligned beam was also observed. The reversibility of particle trajectories in single crystals predicted in the theory is experimentally demonstrated for 500-keV protons moving through a W crystal. The experiments indicated that valuable information about the solid state parameters of the scattering crystal can be obtained. This is illustrated in (1) detection of a disordered surface layer on W, (2) a preliminary study of the distribution of radiation damage introduced into W and Si by heavy-ion bombardment, and of the dependence of this damage on the direction along which the particles are injected into the crystal, and (3) determination of the sites of impurity atoms in a crystal lattice. In the present case, the position of Tm atoms in a Si crystal was determined. (auth)

40109 SOLID STATE REACTION WITH ACCELERATED IONS. Andersen, T.; Sorensen, G. (Univ., Aarhus, Denmark). pp 373-85 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

An electromagnetic isotope separator and a 600-keV ion accelerator have been used for a study of the chemical fate of energetic, singly charged ^{32}P ions implanted in pure and doped crystals of the alkali metal chlorides. The chemical distributions of the ^{32}P atoms were analyzed by dissolving the crystals in water containing hypophosphite, phosphite, and phosphate carriers. The ^{32}P atoms are distributed between the three fractions. The chemical distribution depends on the target preparation method, the energy of the accelerated ions, the dose implanted in the target, and the irradiation temperature. The effects of different types of defects were investigated. No influence on the chemical distribution of the ^{32}P atoms was observed by enriching the sodium chloride crystals with sodium, exposing the sodium chloride crystals to a total dose of 2×10^7 rad of 10-MeV electrons or by introduction of small amounts of divalent cations before the $^{32}P^+$ exposure. Sodium chloride crystals doped with Cu^+, Ca^+, or Ag^+, using the ion implantation technique, exhibited marked temperature-dependent effects on the chemical valence state of subsequent implanted $^{32}P^+$ ions. (auth)

40110 ELECTRON AND POSITIVE HOLE REACTIONS IN KCl–TlCl. Delbecq, C. J.; Ghosh, A. K.; Yuster, P. H. (Argonne National Lab., Ill.). pp 387-97 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

During γ irradiation at 77°K, Cl_2^- and thallium atoms (Tl°) are formed in KCl–TlCl crystals. On warming the irradiated crystals, two glow peaks are observed. The low-temperature glow peak at 208°K is caused by the diffusion of Cl_2^- and the subsequent electron–hole annihilation involving nearby pairs of Cl_2^- and Tl^0. In addition to diffusing into the neighborhood of Tl^0, a Cl_2^- can diffuse into the neighborhood of a Tl^+ and become trapped to form Tl^{2+}. The high-temperature glow peak at 300°K results when electrons are thermally released from thallium atoms into the conduction band and recombination of these electrons and Tl^{2+} takes place. Spectral analysis of the low-temperature glow peak shows that it consists of two emission bands with peaks at 410 and 298 mμ while the high-temperature glow peak consists only of the 298 mμ band. The processes that give rise to these emissions are discussed. The optical absorption of Tl^0 and Tl^{2+} has been measured. The absorption spectrum of Tl^0 consists of very weak bands at 1500 and 1260 mμ, a strong band at 380 mμ, and weak bands at 250, 300, and 640 mμ. Tl^{2+} has strong absorption bands at 220, 262, 294, and 364 mμ. (auth)

40111 THE NATURE OF LUMINESCENCE INDUCED BY PLASTIC DEFORMATION AND LIGHT ILLUMINATION OF γ-IRRADIATED KCl CRYSTALS. Krugloff, A. S. (Inst. of Physics, Obninsk, USSR); El-Shanshoury, I. A. pp 399-415 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

Luminescence of γ-irradiated KCl crystals induced by deformation and illumination with light in the F and M absorption bands was studied. The intensity of light-induced luminescence was found to increase after loading the crystals above the elastic limit. Results confirming the dichroism of color centers responsible for light-induced luminescence were obtained. The crystals bleached with light in the M band recover their ability to emit luminescence after a period of time. The nature of both deformation- and light-induced luminescence is discussed. The interaction between color centers and edge dislocations was proposed to be a general factor affecting the luminescence process. The presence of V-type centers within the dislocation core is considered. (auth)

40112 INVESTIGATION OF SILVER CHLORIDE CRYSTALS FOR DETECTION OF CHARGED PARTICLES. Haase, G.; Schopper, E. (Univ., Frankfurt am Main). pp 417-27 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

It is possible, under certain conditions, to observe microscopically the tracks of charged heavy particles in silver chloride single crystals by decoration following the method of Schockley. Observing and recording of particle tracks in silver chloride crystals may be of particular interest in the field of radiation and nuclear physics. Also, the investigation of track formation by particles in those crystals (combined with electron microscopic methods) provides information on the mechanism of the interaction of the particles with the crystal lattice. The technique of track decoration is described. A special technique of cleaving permits investigation of the structural properties of the crystals by electron microscopic methods combined with the treatment of etching or decoration, and studies of the effects of radiation on a microscopic scale. (auth)

40113 THERMODYNAMIC TREATMENT OF RADIATION-INDUCED PHASE-TRANSFORMATIONS AND ITS APPLICATION TO SOME PEROVSKITES. Hauser, O.; Schenk, M. (Academy of Sciences, Dresden). pp 429-35 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

Samples of $BaTiO_3$, $PbTiO_3$, and $PbZrO_3$ were irradiated in the reactor for doses up to about 14×10^{18} n_f/cm^2. Some aspects which may explain why certain polymorphic substances show radiation-induced phase transformation, while others do not, are discussed. It is shown that this type of transformation can be expected only if other defects cause a shifting of the phase transition temperature towards the temperature of measurement. In this case the defect-induced change of the enthalpy is $\delta H < 0$, which is the case for $BaTiO_3$ and $PbZrO_3$. (auth)

40114 MAGNETIC VISCOSITY INDUCED BY FAST NEUTRON IRRADIATION IN HIGH PERMEABILITY PURE IRON. Ferro, A.; Montalenti, G.; Soardo, G. P. (Istituto Elettrotecnico Nazionale Galileo Ferraris, Turin). pp 475-87 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

The nature of defects introduced by fast-neutron irradiation responsible for magnetic permeability variations in high-permeability pure iron was studied. By comparing the magnetization curves of pure iron specimens irradiated with and without an applied magnetic field, it is shown that permeability changes are due to an induced anisotropy energy associated with anisotropic defects. The mobility and recovery kinetics are studied by taking magnetic viscosity measurements from 20 to 400°C. An activation energy of 0.85 ± 0.05 eV and a relaxation time τ_0^f of about 10^{-11} to 10^{-12} sec are found for the diffusion of the point defects, which are identified as impurity–vacancy couples or possibly as divacancies. These defects disappear at temperatures between 100 and 250°C. The average distance between precipitation centers, evaluated from the time constant of viscosity field recovery, is of the order of 10^{-4} cm, which is in agreement with the data on the distance between defect clusters in irradiated iron obtained by other authors. Experiments on hardness recovery on the same specimens show that the changes in mechanical properties produced by irradiation do not depend on the defects responsible for the magnetic property changes, but on other defects whose recovery occurs between 250 and 400°C. (auth)

40115 LATTICE PARAMETER CHANGE BY POINT DEFECTS IN IRRADIATED ALUMINUM. Peisl, H.; Waidelich, W. (Technische Hochschule, Darmstadt, Ger.). pp 489-95 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid-State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

The distortion of a crystal lattice by point defects was investigated by measuring the lattice-parameter change of irradiated crystals. Pure aluminum foils were irradiated at 4.6°K with neutrons in the low-temperature irradiation facility of the Munich Research Reactor at Garching. Without warming up, the irradiated samples were transferred to a special helium cryostat for the x-ray measurements. The relative lattice-parameter change after irradiation with 2×10^{18} nvt was $\Delta a/a = (4.47 \pm 0.4) \times 10^{-4}$. This irradiation-induced lattice-parameter change anneals completely during an isochronal annealing run in three distinct stages: (1) 10 to 50°K; (2) 50 to 120°K; and (3) 150 to 250°K. By comparing these results with recovery measurements of the residual electric resistivity, stored energy, and length change, the volume change of one Frenkel defect is determined to be 1.4 atomic volumes. Since $\Delta a/a$ is equal to $\Delta l/l$, new lattice sites cannot be produced during the thermal annealing of the defects. This means that each annealing stage must be due to the recombination of interstitials and vacancies in different configurations. (auth)

40116 METHOD FOR STUDYING POINT DEFECTS: ESPECIALLY, INTERSTITIAL ATOMS IN METALS. Budin, Claude; Lucasson, Pierre (Faculte des Sciences de Paris, Orsay, France). pp 497-511 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

A difficulty in the identification and in the study of interstitial atoms in metals is that there is no way to create them without producing other species of crystalline defects at the same time. Curves of damage formation versus incident-particle flux, as well as isochronal or isothermal recover data, made it possible to identify the domains of mobility of interstitial atoms compared to that of vacancies in the same metal by combining electron irradiation and quenching experiments. It was also possible to obtain values of intrinsic properties such as formation energy, resistivity, and formation volume. Studies of the electrical resistivity behavior in quenched and quenched-irradiated aluminum and copper are reported. Recently obtained results concerning identification, movement energy, and intrinsic resistivity of interstitial atoms are given. (auth)

40117 DEFECT STUDIES IN IRRADIATED FERROMAGNETIC METALS OR ALLOYS. Dautreppe, D.; Chamberod, A.; Chambron, W.; Hivert, V.; Minier-Cassayre, C.; Moser, P.; Pauleve, J.; Peretto, P.; Verdone, J.; Vigier, P. (CEN, Grenoble, France). pp 513-23 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

The different models proposed for stage-I recovery are discussed on the basis of recent results of coupled experiments after electron irradiation at 20°K. The coupled measurements are magnetic aftereffect and electrical resistivity, which are measured simultaneously during an isochronal annealing. The discussion is also based on different measurements after neutron irradiation at 28°K, such as magnetic aftereffect, electrical resistivity, stored energy, internal friction, and length variation. Different results on pure iron–nickel alloys neutron- or electron-irradiated at 78 or 20°K are presented. The induced magnetic anisotropy produced by the enhanced diffusion during an isochronal annealing is measured. This physical property is very sensitive since only 2-ppM defects are necessary to give rise to very large effects. Different peaks of enhanced diffusion are observed and discussed. (auth)

40118 ELECTRON MICROSCOPY OF HEAVY ION DAMAGE IN ALUMINUM AND NICKEL. Norris, D. I. R. (Central Electricity Generating Board, Berkeley, Eng.). pp 525-35 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

Defect clusters formed by the bombardment of thin foils of aluminum and nickel with 150-keV xenon ions at 300°K have been studied by electron microscopy. Black-spot images and black–white images yield information on (a) whether a cluster is collapsed to a dislocation loop or is three-dimensional, (b) its Burgers vector if it is a loop, (c) whether it is of vacancy or of interstitial character, (d) whether it is near the ion entrance or the ion exit surface of the foil, and (e) the number of point defects making up the cluster. In aluminum and nickel prismatic loops, Frank loops and three-dimensional clusters are present and they are of vacancy character. In aluminum in a direction close to [112], the density of visible clusters decreases in a distance 2200Å to a fraction 0.06 of its initial value. The largest loops are formed from about 500 vacancies in aluminum and about 250 in nickel. These results are consistent with the view that each cluster corresponds to the site of a displacement cascade. (auth)

40119 REPORTING NEUTRON EXPOSURE FOR RADIATION DAMAGE. Rossin, A. David (Argonne National Lab., Ill.). pp 553-62 of Interaction of Radiation with Solids. Bishay, Adli (ed.). New York, Plenum Press, 1967.

From Solid State Conference on Interaction of Radiation with Solids, Cairo, Sept. 3–7, 1966. See CONF-660923.

A method for determining and reporting the data needed to interpret neutron irradiation experiments is presented. It makes it possible to calculate the number of atoms displaced by the bombardment and provides exposure data in units that eliminate the neutron spectrum as a variable. Thus experimental results from entirely different reactors can be compared directly, even though the fast neutron spectra may be quite different. Reactor spectra always differ from the pure fission spectrum, and these differences become more pronounced at energies below 2 MeV. It has been shown that comparing exposures by quoting $\Phi > 1$ MeV offers very limited accuracy. Usually these attempts were based on activation data from a threshold detecting foil assuming a pure fission spectrum for the fast neutrons, thus introducing another arbitrary error. Recent experience shows that the reaction $^{54}Fe(n,p)^{54}Mn$ is of great value for monitoring radiation damage. It is possible to relate other activation rates and displacement production rates to measured iron activation rates, if the spectra are known. These ratios become a key in determining and reporting exposure. The use of realistic spectra and neutron-energy-dependent damage models was proposed in 1961 and their use is becoming more widespread. Several different units for reporting damage have been proposed. Sample calculations and exposure-rate data for a number of reactor irradiation facilities are included. (auth)

40120 MOESSBAUER EFFECT METHODOLOGY. VOLUME 2. Proceedings of the Second Symposium, New York City, January 25, 1966. Gruverman, Irwin J. (ed.). New York, Plenum Press, 1966. 97p. $12.50. (CONF-660113).

Twelve papers are presented on interdisciplinary studies linking physics, chemistry, biology, and metallurgy through the use of the Moessbauer effect. The measurements of parameters such as Moessbauer fraction, electric field gradient, hyperfine structure, and the localization moments and their interpretation are described. Detailed studies cover Fe coordination numbers,

rare earth intermetallics, Pd–Sn alloys, Fe films, hemoglobin, and meteorites. Quality control applications, metallurgical and chemical laboratory analytical procedures, biological applications, and other areas where Moessbauer spectroscopy can function as a sophisticated and versatile analytical tool are discussed. (S.F.L.)

40121 PREDICTION OF SPACE RADIATION EFFECTS ON TRANSISTORS AND SOLAR CELLS. Holmes-Siedle, A. G.; Liederbach, F. J.; Poch, W. J. (RCA, Princeton, N. J.). 16p. (CONF-660563-1). DTIE.

From 7th IEEE Annual Conference on Electronic Reliability, Princeton, N. J.

A general discussion is given on the space radiation environment and its damage producing capability. A recently completed detailed investigation of potential radiation damage to the TIROS Operational Satellite provides a specific example of a typical radiation hardening procedure. Of primary concern is the possible degradation in performance of solar cells and transistors. Methods for predicting the unavoidable effects of space radiation on these devices are described. Principal emphasis is placed on a technique for estimating the decrease in transistor forward current gain (β) as a function of dose. An analysis of extensive test results shows that an ionization damage factor ($\Delta 1/\beta_i$) can be assigned to most transistor types. From experimentally determined values of this damage factor, the maximum anticipated transistor β loss can be predicted as a function of dose, collector current, and duty cycle. Transistors with relatively wide bases such as some power transistors are also subject to significant bulk damage. This can be characterized by another damage factor ($\Delta 1/\beta_B$) readily determined by means of an analytical expression. Special nomograms which facilitate the calculation of both damage factors have been developed. Overall β loss from combinations of both damage effects can readily be determined with these aids. (auth)

Theoretical Physics

Refer also to abstracts 39718 and 39829.

40122 (JINR-P4-3405) ZADACHA DVUKH TSENTROV KVANTOVOI MEKHANIKI. IV. MATRICHNYE ELEMENTY. (Two-Center Problem of Quantum Mechanics. IV. Matrix Elements). Ponomarev, L. I.; Puzynina, T. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 47p. (In Russian). Dep.

The results of calculations of some matrix elements by the wave functions of the two-center problem are presented in tables. It is necessary to know them while describing the processes involving three bodies which interact according to the Coulomb law. (auth)

40123 (ORNL-TM-1949) NUMERICAL EVALUATION OF CLEBSCH-GORDAN AND RACAH COEFFICIENTS. Wills, John G. (Oak Ridge National Lab., Tenn.). Aug. 15, 1967. Contract W-7405-eng-26. 14p. Dep. CFSTI.

Two FORTRAN codes have been written to compute Clebsch–Gordan and Racah coefficients. These coefficients have the form of a product of factorials multiplied by a sum, each term of which is itself a product of factorials. The method used here is to extract all of the factorials from the sum leaving a simple sum of the form $1 - x + xy - xyz + \ldots$ which is easily formed as $1 - x(1 - y)1 - z \ldots$. Then the factor which multiplies the sum is formed by combining the logarithms of the factorials followed by one exponentiation. These codes have been compared to those of T. Tamura on the IBM-360, Model 75 and CDC-1604A computers and are found to be faster and more accurate. In addition to FORTRAN function subprograms, a package exists for evaluation of these coefficients on the ORNL-160A computer. (auth)

40124 SOLUTION OF THE RELATIVISTIC COLLISIONLESS BOLTZMANN EQUATION IN PRESENCE OF CERTAIN EXTERNAL FIELDS. Abonyi, I. (Univ. Roland Eoetvoes, Budapest). Acta Phys. Acad. Sci. Hung., 23: 247-50(1967). (In Hungarian).

A system of identical particles with a rest mass M_0 and exposed to an external force is considered. The integration of the relativistic Boltzmann equation is solved for the case where the mutual interaction of the particles can be neglected, for example because of very low density. It was shown that a solution of the relativistic Boltzmann equation for this case exists only for fields which are constant on the universe lines. (J.S.R.)

40125 THE RELATIVISTIC AND SPIN-DEPENDENT PART OF THE HAMILTONIAN OF THE ELECTRON. Zybell, E. (Univ., Frankfurt am Main). Z. Phys., 205: 159-73(1967). (In German).

Two aspects of the relativistic Hamiltonian of the electron are investigated in the nonrelativistic limit: (1) the Hamiltonian is correctly expanded in powers of v/c instead of 1/m; and (2) by comparing with the spin zero case it is decided which terms are a consequence of the spin (or magnetic moment). The results are applied to the fine-structure levels of hydrogen. (auth)

40126 ANHARMONIC OSCILLATOR IN QUANTUM MECHANICS AND IN FIELD THEORY. Mueller, Harald J. W. (American Univ. of Beirut). Z. Phys., 205: 149-58(1967).

A modified Rayleigh–Schroedinger perturbation method is used to derive explicit expansions for the eigenvalues and eigensolutions of the anharmonic oscillator. The dual relationship between the anharmonic oscillator and the Schroedinger equation for a Yukawa potential is pointed out. Finally an application of the method to a field-theoretic Hamiltonian is considered, since the anharmonic oscillator plays a dominant role in many field-theoretic models. (auth)

40127 GRAVITATIONAL OSCILLATIONS OF INCOMPRESSIBLE FLUID SPHERES. Macke, W.; Voss, K.; Weiss, H.-J. (Technische Univ., Dresden). Z. Astrophys., 67: 24-40(1967). (In German).

The frequency spectrum of an inhomogeneous incompressible perfect liquid influenced only by its own gravitation is investigated. The frequencies are classified by three parameters l, m, and n. Because of the symmetry of the problem the angular dependence of the deviation is represented by spherical harmonics Y_{lm}. For non-rotating homogenous liquid spheres the frequencies depend only on l. Here is investigated the removing of n-degeneracy by an inhomogeneous mass distribution. For the inhomogeneous liquid the frequencies are calculated as eigenvalues of a linear homogeneous integro-differential equation. Using a variational method one can obtain approximations giving good numerical results. (auth)

40128 STUDIES ON X AGENT. LIII. INTERPRETATION OF X AGENT IN TERMS OF QUANTUM THEORY. Moriyama, Hideo (Shonan Hygiene Inst., Kamakura, Japan). Yokohama Med. Bull., 18: 23-38(Apr. 1967).

X agent is postulated to be a quantum consisting of 2 photons, which can sometimes differ. Therefore, X agent has an energy about twice as great as a usual photon. In this respect, X agent is regarded as a photon activated by energy nearly equivalent to that of a photon. Upon combination, one of the photons acquires a positive and the other a negative nature, that is, the photon becomes dissociable into posiphoton and negaphoton. The X agent is said to exert effects that are sometimes positive and sometimes negative. If such a quantum of X agent affects matter, the matter is activated, whereby the special energy of the agent is transferred to the matter. This energy is equivalent to a component photon, so that the X agent becomes a normal photon on losing the energy. X agent when produced by activated matter from a normal photon is designated as a secondary agent, while that produced through a direct combination of 2 photons without intervention of activated matter is called a primary agent. The 2 components in the primary agent are usually the same, but those in the secondary agent may be different. Various phenomena attributed to the interaction of X agent with matter are interpreted on the basis of these postulates. (BBB)

40129 NEW APPROACH TO UNIFIED FIELD THEORY. Blackman, Jerome (Syracuse Univ., N. Y.). J. Math. Phys. (N. Y.), 8: 983-7(May 1967).

A new approach to a unified field theory combining Einstein's gravitational equations and the Maxwell equations is developed using a geometry in which GL(4, C) replaces GL(4, R) as the group of the principal bundle. The resulting equations are the same as Einstein's in the case of empty space but differ from those he proposed for the conbined gravitational and electromagnetic fields. Charge is shown to appear only at singularities, and a symmetric solution corresponding to the classical Schwarzschild metric is presented. (auth)

40130 SPINOR FIELDS AS DISTORTIONS OF SPACE–TIME. Hestenes, David (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 8: 1046-50(May 1967).

Spinor fields are introduced into Riemannian space–time in a new way. This approach admits a simple geometrical interpretation of spinor fields. A linear connection for space–time is derived which describes both gravitational and nongravitational forces. It is consistent with a straightforward generalization of the Dirac equation. This theory also entails a physical interpretation of inertial coordinates. The spin and current vectors of a spinor field are not in general orthogonal. This lack of orthogonality provides an absolute measure of one component of the gravitational field as seen in an inertial system. (auth)

40131 THREE-DIMENSIONAL FORMULATION OF GRAVITATIONAL NULL FIELDS. II. Misra, R. M.; Singh, R. A. (Univ. of Gorakhpur, India). J. Math. Phys. (N. Y.), 8: 1065-8(May 1967).

It was previously shown that three types of gravitational null fields may be characterized on the analogy of the electromagnetic field. The first two types have been discussed, and the remaining third type (C) of gravitational null field is considered. The necessary and sufficient condition that the gravitational field be of type C is obtained. The formalism is also extended to include nonempty gravitational fields. It is shown that the nonempty space–time may also admit three types of gravitational null fields under certain circumstances. A typical case is discussed as an example. (auth)

40132 DYNAMICS OF PRESSURE-FREE MATTER IN GENERAL RELATIVITY. Ellis, G. F. R. (Univ. of Texas, Austin). J. Math. Phys. (N. Y.), 8: 1171-94(May 1967).

An orthonormal tetrad system and associated coordinate system is obtained, which may be used to locally describe any dust-filled space–time. This is used to study dust-filled spaces in which there exist multiply transitive groups of motions; all such spaces are classified in detail. Spaces containing shear-free dust are also considered; it is shown that $\sigma = 0 \rightarrow \omega\Theta = 0$. Three classes of solution with $\sigma = 0$, $\omega \neq 0$ are studied. Several new solutions of the field equations are contained in these results. (auth)

40133 SPACE–TIMES CONTAINING PERFECT FLUIDS AND HAVING A VANISHING CONFORMAL DIVERGENCE. Shepley, L. C.; Taub, A. H. (Univ. of California, Berkeley). Contract AT(11-1)-34. Commun. Math. Phys., 5: 237-56(1967).

The solutions of the Einstein field equations are studied under the assumptions that (1) the source of the gravitational field is a perfect fluid, (2) the divergence of the conformal (Weyl) tensor vanishes, and (3a) either an equation of state exists such that $p = p(w)$, p being the pressure and w the rest energy density, or (3b) the rest particle density is conserved. Under assumptions (1), (2), and (3a) it is shown that the space–time is conformally flat and the metric is a Robertson–Walker metric. The flow is irrotational, shear-free, and geodesic. Under assumptions (1), (2), and (3b) it is shown that either the line element is static or the fluid has a very special caloric equation of state. Conditions for a static solution to exist are examined, and it is shown that the Schwarzschild interior solution satisfies these conditions as does the Einstein Universe. The Schwarzschild interior and the Einstein Universe are the only conformally flat, static solutions obeying (1), (2), and (3b). (auth)

40134 A SPHERICALLY SYMMETRIC SOLUTION OF THE MAXWELL–EINSTEIN EQUATIONS. Lovelock, D. (Univ. of South Africa, Pretoria). Commun. Math. Phys., 5: 257-61(1967).

A spherically symmetric solution of the "already unified field theory" of Rainich (i.e., of the source-free Maxwell–Einstein equations) is presented which represents a static massless charged particle. It is not equivalent to the Reissner–Nordström solution with zero mass, although both metrics repel uncharged test particles. (auth)

40135 DELTA-FUNCTION FERMI GAS WITH TWO-SPIN DEVIATES. Flicker, Michael (Case Inst. of Tech., Cleveland. Western Reserve Univ., Cleveland); Lieb, Elliott H. Phys. Rev., 161: 179-88(Sept. 5, 1967).

The problem of one-dimensional particles interacting via a delta-function potential has been a useful model for the many-body problem. While it can be solved for bosons, it has so far not been solved for fermions except for the special cases of either all spins parallel or all but one spin parallel. The full difficulty of the problem first manifests itself when two spins are down (i.e., $S = \frac{1}{2}N - 2$), and this is solved here. It is expected that the method can be extended to the general problem. (auth)

40136 CLIFFORD ALGEBRAS IN GENERAL RELATIVITY. Lord, E. A. (London Univ.). Proc. Cambridge Phil. Soc., 63: 785-807(July 1967).

The generalization of the Dirac and quaternion algebras to Riemannian spaces is outlined. The components of various elements of the algebras are interpreted as physical quantities (tensors) and their symmetries and algebraic properties are linked with the properties of the algebra. The generalization of the quaternion algebra is of particular interest in that it resolves the anomalies that arise in the usual identification of quaternions with rank two spinors. Algebraic expressions for the electromagnetic energy momentum tensor, the Ricci tensor, and Einstein tensor are obtained in both E number and quaternion form. Extension of the principles to EF numbers yields a proof of the symmetry properties of Bel's tensor and a simple expression for its divergence. (auth) (UK)

40137 MANY-BODY PROBLEMS. VOLUME I. Lectures Given at the Niels Bohr Institute and NORDITA, Copenhagen. Brown, G. E. Copenhagen, NORDITA, 1966/67. 119p.

Three lectures on the many-body problem are presented covering the topics of self-consistent fields (occupation number representations), perturbation theory, and excitations and Green functions. (W.D.M.)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Electromagnetic

40138 (ORO-3065-14) EXPERIMENTAL RESULTS FROM $K^- + p \rightarrow \lambda + \eta$. Cox, B. B.; Fortney, L. R.; Carpenter, D. W.; Rose, C. M.; Fowler, E. C. (Duke Univ., Durham, N. C.). Aug. 17, 1967. Contract AT(40-1)-3065. 18p. Dep. CFSTI.

Data are presented for the first half of the film for meson (K^-) interactions at 740 MeV/c in a hydrogen bubble chamber. Several event topologies in the film were analyzed in an attempt to measure all the branching ratios for all the η decay events. The values measured for all these branching ratios are given. (J.F.P.)

40139 RADIATION CORRECTIONS FOR INELASTIC ELECTRON SCATTERING BY COINCIDENCE COUNTING. Urban, P.; Widder, F. (Univ., Graz). Acta Phys. Austr., 25: 141-7(1967). (In German).

The theoretical treatment of radiative correction to the inelastic scattering process with coincidence counting was represented previously on the example $e + p \rightarrow e + n + \pi^+$. Some improvements to the kinematic part of the calculation were made in the program and the results for the $e + p \rightarrow e + n + \pi^+$ and $e + d \rightarrow p + n + e$ processes were reported. (J.S.R.)

Weak

40140 QUASI-ELASTIC EVENTS OF THE CERN BUBBLE CHAMBER NEUTRINO EXPERIMENT AND THE DETERMINATION OF THE AXIAL FORM FACTOR. Orkin-Lecourtois, A.; Piketty, C. A. (Ecole Normale Superieure, Orsay, France. Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cim. (10), 50A: 927-34(Aug. 21, 1967).

A new study is made of the CERN bubble chamber quasi-elastic neutrino events, with the help of a theoretical estimate of the cross section for a type of phenomenological event in which the emitted proton is scattered elastically inside the nucleus. A recent estimate of the ν-spectrum makes it possible to use absolute rates for the estimate of the axial form factor parameter M_A. (auth)

40141 ENERGY DEPENDENCE IN THE $K^0_{\ell 3}$ DECAY FORM FACTOR. Kadyk, John A.; Chan, Jonathan H.; Drijard, Daniel; Oren, Yona; Sheldon, Bryce M. (Univ. of California, Berkeley). Phys. Rev. Lett., 19: 597-600(Sept. 4, 1967).

In a very low momentum K^0_L beam, a sample of $K^0_L \rightarrow \pi^\pm e^\mp \nu$ decays was identified in the 25-in. hydrogen bubble chamber by means of bubble density. Based on 531 events, the energy-dependence parameter for the $K^0_{\ell 3}$ vector form factor was determined by $\lambda = +0.01 \pm 0.015$, which is consistent with no energy dependence. (auth)

40142 XII INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS, DUBNA, AUGUST 5-15, 1964. VOLUME 2. Smorodinskii, Ya. A.; Grishin, V. G.; Komar, A. A.; Nikitin, V. A.; Solovev, L. D.; Korenchenko, S. M. (eds.). Moscow, Atomizdat, 1966. 603p. (In English and Russian). (CONF-550-(Vol. 2)).

One hundred eighteen papers were presented at the XII International Conference on High Energy Physics. The topics covered include: neutrino physics, weak interactions of nonstrange particles; weak interactions of strange particles, weak interactions (theory); new ideas; advances in spark and luminescent chambers and counters method; advances in data processing systems for physical experiments; advances in bubble chamber techniques; and methods of production and separation of high energy particle beams. Abstracts of the papers were previously included in NSA under CONF-550. These can be located through a cumulative report number index. (L.B.S.)

Strong (Baryon-Induced)

40143 (JINR-P1-3399) OBRAZOVANIE ZARYAZHENNYKH PIONOV PRI SOUDARENIYAKH NEITRONOV S ENERGIEI 600 MeV S YADRAMI RAZLICHNYKH ELEMENTOV. 1. EKSPERIMENT. (Charged Pion Production in 600 MeV Neutron Collisions with Nuclei of Different Elements. I. Experiment). Oganesyan, K. O. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 29p. (In Russian). Dep.

Charged pion production in the collisions of neutrons with Be, C, Al, Cu, and Pb nuclei was investigated by a magnetic spectrometer in the large angle region. The pion spectra of both signs are obtained on these nuclei at the angles 16, 30, 60, 90, and 123°. The cross sections, atomic number dependencies and angular characteristics of the pion production are found with the aid of these spectra. (auth)

40144 (JINR-P1-3400) OBRAZOVANIE ZARYAZHENNYKH PIONOV PRI SOUDARENIYAKH NEITRONOV S ENERGIEI ~600 MeV S YADRAMI RAZLICHNYKH EDEMENTOV. II. OBSUZHDENIE REZUL'TATOV EKSPERIMENTA. (Charged Pion Production in ~600 MeV Neutron Collisions with Nuclei of Different Elements. II. Discussion of the Experiment). Oganesyan, K. O. (Joint Inst. for Nuclear Research, Dubna (USSR) Lab. of Nuclear Problems). 1967. 28p. (In Russian). Dep.

The results of the experiments on charged pion production in collisions of neutrons with nuclei are analyzed. The influence of a number of effects on the characteristics of the pion production on nuclei are discussed. (auth)

40145 EVIDENCE FOR A N*(1450) IN pp COLLISIONS AT 10 GeV/c. Almeida, S. P. (Cavendish Lab., Cambridge, Eng.); Rushbrooke, J. G.; Scharenguivel, J. H.; Behrens, M.; Blobel, V.; Dehne, H.-C.; Diaz, J.; Schaefer, R.; Swanson, W. P.; Borecka, I.; Kries, G. Nuovo Cim. (10), 50A: 1000-5(Aug. 21, 1967).

Data from the interactions $p + p \rightarrow p + p + \pi^+ + \pi^-$, of which 1133 events were found, and $p + p \rightarrow p + n + \pi^+$, of which 657 events were found are presented. For these interactions the hydrogen bubble chamber was exposed to a 10.01 ± 0.01 GeV/c proton beam. Mass distributions are shown for both interactions. It is believed that the enhancement in the $p\pi^+\pi^-$ mass distribution at about 1450 MeV/c^2 cannot be explained by the OPE model considered. Thus the 1450-MeV/c^2 peak is tentatively interpreted as the P_{11} isobar inferred from $\pi + N$ phase-shift analyses. (J.F.P.)

40146 ANTIPROTON-PROTON ANNIHILATIONS INTO FIVE PIONS AT 5.7 GeV/c. Alles-Borelli, V. (CERN, Geneva); French, B.; Frisk, A.; Michejda, L.; Paul, E. Nuovo Cim. (10), 50A: 776-95(Aug. 21, 1967).

A study of 872 events of the reaction $\bar{p}p \rightarrow \pi^+\pi^+\pi^-\pi^-\pi^0$ is reported. The cross section for this reaction is found to be (0.9 ± 0.1) mb. The position pions tend to be emitted in the direction of the proton and the negative pions in the direction of the antiproton. The forward to backward and polar to equatorial ratios $(F - B)/(F + B)$ and $(P - E)/(P + E)$ are found to be 0.17 ± 0.02 and 0.27 ± 0.02 respectively, the former value corresponding to an excess of two-thirds of a π^+ or a π^- per event in the backward direction respectively in the cms. There is a considerable amount of $\rho^{0\pm}$, ω^0, and f^0 resonance production but no A_1, A_2, or B meson production was observed. No evidence for an associated production of resonances was found which makes any simple interpretation of the annihilation process in terms of three-meson final states difficult. In the $\pi^+\pi^-\pi^0$ mass distribution an enhancement is seen with a mass (2207 ± 13) MeV and width (62 ± 52) MeV which could correspond to the neutrally charged state of the peak observed by Chikovani et al. at 2195 MeV. A simple model is proposed which explains part of the data on four- and five-pion annihilations. (auth)

40147 EXPERIMENTAL RESULTS ON $\bar{p}p$ ANNIHILATIONS AT 1.2 GeV/c WITH PRODUCTION OF AT LEAST ONE K^0_1-MESON. Barlow, J. (CERN, Geneva); Lillestol, E.; Montanet, L.; (and others). Nuovo Cim. (10), 50A: 701-18(Aug. 21, 1967).

Results on annihilations of antiprotons at 1.2 GeV/c into two-, three-, and four-body final states including at least one visible K^0_1 are presented. The three- and four-body channels are dominated by $K^*(891)$. Resonances in the $K\bar{K}$ and $K\bar{K}\pi$ systems are discussed and cross sections are given. It is found that at 1.2 GeV/c it is no longer true that annihilation occurs predominantly from S-states. (auth)

Strong (Meson-Induced)

40148 (JINR-P1-3441) OTSENKA SECHENIYA OBRAZOVANIYA Λ I Σ^0 CHASTITS V SVINTSE DOLGOZHIVUSHCHIMI K^0 MEZONAMI SO SREDNEI ENERGIEI E = 150 MeV. (Estimation of Production Cross Section of Λ and Σ^0 Particles in Pb by Long-Lived K^0 Mesons with the Mean Energy E = 150 MeV). Mestvirishvili, A. N.; Nyagu, D.; Petrov, N. I.; Rusakov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 7p. (In Russian). Dep.

The cross section of Λ and Σ^0 particle production in Pb by long-lived K^0-mesons with the energy E = 150 MeV is measured. The cross section is found to be $\sigma = (212 \pm 38) \cdot 10^{-27}$ cm^2. (auth)

40149 (JINR-P1-3446) ROZHDENIE Ξ^- GIPERONOV V π^--N BZAIMODEISTVIYAKH PRI IMPUL'SE 4,0 GeV/c. (The Ξ^- Hyperons Production in the π^-–N Interactions at an Energy 4.0 GeV/c). Atayan, M. R.; Bannik, B. P.; Grigoryan, N. G.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1967. 8p. (In Russian). Dep.

An analysis is performed of the Ξ^- hyperon production in the π^-–N interactions at 4 GeV/c in a propane bubble chamber. The production cross section at this energy is estimated to be $1.5^{+\frac{3}{1.5}}_{-1.5}$ mb. A comparison with other experimental results is given.

40150 (UCRL-17089) RESONANCES IN THE REACTION $K^-n \to \Sigma^- \pi^+\pi^-$ FROM 1660 MeV TO 1900 MeV. Bell, Robert Brooks (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1966. Contract W-7405-eng-48. 84p. Dep. CFSTI.

Thesis.

The reaction $K^- n \to \Sigma^- \pi^+ \pi^-$ was studied in the K^- n center of mass energy range from 1660 MeV to 1900 MeV. Three strangeness minus one baryon resonances are definitely observed; two of these isobars, the $Y_1^*(1520)$ and $Y_1^*(1405)$, are produced with the negative pion and then decay into the $\Sigma^- \pi^+$ final state. The third, the $Y_1^*(1760)$, undergoes the decay $Y_1^*(1760) \to Y_1^*(1520)\ \pi^-$. It is also possible that the high energy tail of the $Y_1^*(1660)$ is present in the data. The $\Sigma^- \pi^-$ final state has isospin two and an extensive search was made for any enhancement which might indicate the presence of a Y_1^{**}; no evidence for the existence of a doubly charged strange resonance decaying into $\Sigma^- \pi^-$ was found anywhere in the available energy region of this experiment. It was possible to unambiguously determine the spin and parity of the $Y_1^*(1760)$ by an examination of the production angular distribution of the $Y_1^*(1520)$ produced in the reaction $K^- n \to Y_1^*(1760) \to Y_1^*(1520)\ \pi^-$ and the decay distribution of the $Y_1^*(1520)$ into $\Sigma^- \pi^+$. No information concerning the quantum numbers of the $Y_1^*(1660)$ could be obtained from the data. (auth)

40151 INVESTIGATION OF THE $\pi^- + p \to \pi^- + p + m\gamma$ REACTION ($m \geq 1$) AT THE π^- MOMENTUM 4 GeV/c. Lyubimov, V. B.; Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 6: 94-7(July 1967). (In Russian).

The interactions with the emission of at least one detected γ-quantum were investigated on the photographs from the 24 liter propane bubble chamber bombarded with the π^--meson at 3.97 ± 0.06 GeV/c. The results are presented of the analysis of 498 two-prong events with the secondary proton momentum from 180 to 500 MeV/c in the lab. system. (auth)

40152 MESONIC DECAYS OF SPALLATION HYPERFRAGMENTS AND THE Λ-N POTENTIAL-WELL DEPTH. Kang, Y. W.; Zaffarano, D. J. (Iowa State Univ., Ames). Phys. Rev., 160: 972-80(Aug. 20, 1967). (IS-1319)

The short-range ($\lesssim 10\ \mu$) mesonic hyperfragments produced by 1.1-BeV/c K^- mesons and 2.3-BeV/c K^- mesons in K5 nuclear emulsions were studied in order to estimate the potential-well depth of the Λ-N interaction. Among more than 261,000 K^- interactions examined, 70 mesonic decays were observed which consist of 41 heavy hyperfragments, 28 light hyperfragments, and one π^+ decay. Based on eight π^--p-r decays (r indicates residual nucleus) in the lower region of a plot of binding energy versus mass, the upper limit of the potential-well depth of the Λ-N interaction was estimated to be 27.7 ± 0.6 MeV, assuming a square-well potential. A further elaboration of a more accurate estimate of the binding energy and consequently derived potential-well depth is discussed. The nonmesonic-to-π^--mesonic decay ratio of the heavy hyperfragments ($A = 65 \pm 40$) was estimated to be 153 ± 27. This value agrees fairly well with the theoretical ratio 130 at A = 100, estimated by Dalitz. The study of 28 light-hyperfragment events indicates that $(75 \pm 22)\%$ of the light hyperfragments originated in light nuclei (O, N, C). (auth)

Particle Interactions and Properties (Theoretical)

General

40153 THEORY OF DISINTEGRATION OF PARTICLE SYSTEMS. Vagradov, G. M. Acta Phys. Pol., 31: 985-92(1967). (In Russian).

The problems on the spontaneous decay of systems of interacting particles were examined by the multiparticle field theory method. By means of projection operators, used in the theory of nuclear reactions, the exact equations for the determination of the wave functions and the position and width of nonstationary levels were obtained. Analogous results were obtained for colliding particles with formation of intermediate unstable states. (tr-auth)

40154 MULTIPLE-PRODUCTION THEORY VIA TOLLER VARIABLES. Bali, Naren F.; Chew, Geoffrey, F.; Pignotti, Alberto (Univ. of California, Berkeley). Phys. Rev. Lett., 19: 614-18(Sept. 4, 1967).

Toller's group-theoretical analysis of kinematics is exploited to define a complete set of variables, each of independent range, for particle production of arbitrary multiplicity. In terms of these variables, the generalized Regge-pole hypothesis leads to a simple, unambiguous, and experimentally accessible prediction for high-energy multiple-production cross section. A flat Pomeranchuk trajectory is shown to violate the Froissart bound. (auth)

40155 COMPATIBILITY OF QUARK AND REGGE-POLE MODELS. Daboul, J. (Weizmann Inst. of Science, Rehovoth, Israel). Nuovo Cim. (10), 50A: 850-70(Aug. 21, 1967).

The special Regge pole model suggested by Freund to explain high-energy cross sections is generalized by I) giving up the SU_3 symmetry of the residue functions and II) assuming that the exchanged mesons could be mixtures of the unitary singlet and octet. These generalizations are shown to be necessary and sufficient for compatibility of this model with the general quark model, without symmetry assumptions. The assumption I) allows one, for example, to account for the experimental values of the differences $\sigma_t(\pi^-P) - \sigma_t(K^-P) \approx \sigma_t(\pi^+P) - \sigma_t(K^-N)$ and at the same time satisfy $\sigma_t(K^+N) = \sigma_t(K^+P)$. The generalization II) leads to the following results: It is possible to obtain Freund's relations without assuming M_{12} symmetry, only if the exchanged isosinglet vector mesons are certain mixtures of unitary singlet and octet as to correspond to the physical ω and φ mesons. This mixing angle leads naturally to the equality of the quark-quark amplitudes $T_{p\lambda}$ and $T_{\bar{p}\lambda}$ at all energies. The symmetry-breaking term in the total cross sections must vanish at very high energies, if no singlet-octet mixing for the tensor mesons is allowed. The symmetry-breaking term need not vanish in the quark model. Further, zero mixing cannot explain the energy behavior of the averages $S_\pi \equiv \frac{1}{2}[\sigma_t(\pi^+P)] + \sigma_t(\pi^-P)]$ and $S_K \equiv \frac{1}{4}[\sigma_t(K^+P) + \sigma_t(K^-P) + \sigma_t(K^+N) + \sigma_t(K^-N)]$. A mixing angle for the I = 0 tensor mesons, which is equal to that needed for the vector mesons to obtain ω and φ, leads to a clear contradiction of the experimental data. However, a mixing angle which is close to it can explain the energy behavior of the S_π and S_K and also leads to the prediction that both S_π and S_K tend to nonvanishing values at infinite energies with $S_K(\infty) > S_\pi(\infty)$. No additional Pomeranchuk pole to the tensor nonet is needed. The energy dependence of $S_N = \frac{1}{4}[\sigma_t(PP) + \sigma_t(PN) + \sigma_t(\bar{P}P) + \sigma(\bar{P}N)]$ can be accounted for by breaking universality. However, one can do that without introducing D-coupling of the baryons. If one tries to identify the two I = 0 tensor mesons with the physical f(1250) and f' (1525), then the mixing angle for I = 0 tensor mesons indicates that f' rather than f should have an intercept $\alpha(0) = 1$. (auth)

40156 PROPERTIES OF THE COLINEARIZED ALGEBRA OF VECTOR DENSITIES IN THE INFINITE-MOMENTUM REPRESENTATION. Barnes, K. J. (Imperial Coll. of Science and Tech., London); Williams, R. M.; Kazes, E.; Paton, J. Nuovo Cim. (10), 50A: 935-44(Aug. 21, 1967).

Properties of the colinearized algebra of vector densities are studied in the infinite-momentum representation and are found to imply in particular that oscillating physical form factors are predicted in any finite-particle saturation where nontrivial solutions exist. (auth)

40157 BREAKDOWN OF THE ASSOCIATIVE LAW FOR CURRENT OPERATORS IN A MODEL IN TWO-DIMENSIONAL SPACE-TIME. Konisi, Gaku; Yamamoto, Kunio (Kwansei Gakuin Univ., Nishinomiya, Japan). Progr. Theor. Phys. (Kyoto), 37: 1314-18(June 1967).

A simple example in the two-dimensional space-time is presented where the products of current operators are defined in a strict sense and yet the associative law is violated. (auth)

40158 A QUANTUM THEORY OF THE RIGID BODY IN TERMS OF A TWO-COMPONENT SPINOR. Hara, Osamu; Goto, Tetsuo; Tsai, S. Y.; Yabuki, Haruichi (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 37: 1319-29(June 1967).

It is shown that the motion of the rigid body can be described very conveniently in terms of a two-component spinor. The advantage of this description over the usual one using the Euler angles is that in this description all expressions are written in a manifestly covariant form. The discussion is mainly quantum mechanical and is restricted to the nonrelativistic case. (auth)

40159 WAVE EQUATION FOR RADIATIONLESS PARTICLES. Hokkyo, Noboru (Hitachi Central Research Lab., Ozenji, Japan). Progr. Theor. Phys. (Kyoto), 37: 1330-6(June 1967).

A wave equation is proposed for the massless spin $\frac{1}{2}$ particle moving along the radiationless trajectory. The equation is a nonlinear integro-differential equation, the nonlinearity being due to retarded self-interactions. In the limit of vanishing retardation

the equation reduces to the Heisenberg form of nonlinear wave equation. The particle mass arises from the nonlinear term of the equation and seems to be related to the number of time reversals of the radiationless trajectory per unit time. (auth)

40160 STUDIES IN THE THEORY OF THE GENERALIZED DENSITY OPERATORS. II. SYSTEMS OF IDENTICAL PARTICLES. Brandstatter, J. J.; Peltzer, C. (Stanford Research Inst., Menlo Park, Calif.). J. Math. Anal. Appl., 19: 179-96 (July 1967).

The main properties of the generalized density operators D^p associated with an n-particle wave function ψ were previously derived, and it was shown that in the absence of symmetry restrictions on ψ, the D^p's were completely characterized by requiring them to be positive operators of trace 1 on the p-particle space. Some of the additional properties of the generalized density operators which result from the symmetry requirements on the wave function of systems of all identical particles are established. (J.F.P.)

40161 UNITARITY CONDITION AND ANGULAR DISTRIBUTIONS IN ELASTIC AND INELASTIC PROCESSES. Dremin, I. M. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 6: 153-7(July 1967). (In Russian).

The model which includes only the binary inelastic processes is studied. The shadow elastic scattering in the model is shown to have a wider angular distribution than that of binary processes. The equivalence of the conclusions drawn on the basis of this model and that of Van Hove is shown for elastic scattering with small four-momentum transfer. The inelastic processes are discussed in relation to the possibility of making choice between the two models. (auth)

40162 GROUP PROPERTY OF CREATION AND ANNIHILATION OPERATORS. Sannikov, S. S. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh., 12: 872-4(May 1967). (In Russian).

Let $A(a_i)$ be the algebra of annihilation and creation operators: $a_i a_j - a_j a_i' = \epsilon_{ij}$ and i, j = 1, 2, and let ϕ be the linear space in which these operators act. The A linear canonical transformations $a_i \to a_i' = u_{ij} a_j$ with matrices $u \in SU(2)$ are considered. Angular momenta operators are found that give representations of the SU(2) group, which correspond to the spin λ. The form of the canonical functions is given. (TTT)

40163 DISPERSIONNAYA TEORIYA VZAIMODEISTVIYA ELEMENTARNYKH CHASTITS. (Dispersion Theory of Elementary Particle Interactions). Granovskii, Ya. I. Tartu, Tartu State Univ., 1966. 179p.

In the first chapter a brief review is given on the quantum electro- and mesodynamics using a dispersion method instead of the ordinary method based on the equations of motion and Feynman diagrams. The method operates directly with matrix element of the studied process. The necessary approximations are introduced following the general analysis. The measured objects in the dispersion method are physical and do not possess any infinities. Corrections for Schwinger's equation for electron magnetic moment and operations with finite values are the advantages of the dispersion method. Typical electromagnetic, nuclear and weak interactions are discussed in the following three chapters. (R.V.J.)

Electromagnetic

40164 (DESY-67/16) A MONTE CARLO CALCULATION OF CASCADE SHOWERS IN COPPER DUE TO PRIMARY PHOTONS OF 1 GeV, 3 GeV, AND 6 GeV, AND TO A 6 GeV BREMSSTRAHLUNG SPECTRUM. Voelkel, Uta (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). May 1967. 45p. Dep.

The radial and longitudinal development of electron-photon showers in copper was calculated by a Monte Carlo method. Radial, angular, and energy distributions of the particles were computed, as well as the distribution of the energy deposited in the material. The primaries chosen are monoenergetic photons of 1, 3, and 6 GeV, and a 6 GeV bremsstrahlung spectrum. Some conclusions are drawn for a copper quantameter. (auth)

40165 (IAE-1201) RASCHET ELEKTROMAGNITNYKH LIVNEI V SVINTSE S NACHAL'NOI ENERGIEI 6 GeV. (Calculation of Electromagnetic Showers in Lead With Initial Energy of 6 GeV). Varfolomeev, A. A.; Drabkin, L. B. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1966. 36p. (In Russian). Dep.

Lateral distributions in electromagnetic cascades are obtained using Monte Carlo methods for the case of an electron primary energy 6 GeV and electron secondary energies greater than 10 MeV with depth ranging from zero to 10 radiation lengths in lead absorber. The following processes were considered: bremsstrahlung, pair production, multiple scattering and ionization loss. In using Bethe-Heitler cross sections the screening effect was taken into account in accordance with the Thomas-Fermi model and correction to Born approximation was introduced. There were 1000 cascades followed with an electron digital computer. Numerical results are presented for electron number distributions of cascades for radial and angular distributions of electrons and positrons, for energy spectrum of electrons and positrons and some additional data on particles not followed in cascades. (auth)

40166 (MIT-2098-359) QUARK MODEL PREDICTIONS FOR HADRON DECAYS. II. ELECTROMAGNETIC DECAYS. Dar, A. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Aug. 14, 1967. Contract AT(30-1)-2098. 22p. (CONF-670923-1). Dep. CFSTI.

From 3rd International Symposium on Electron and Photon Interactions at High Energies, Stanford, Calif.

The predictions of two quark model for the electromagnetic decay model of the fundamental pseudoscalar and vector meson nonets and of the fundamental baryon octet and decuplet are compared. The electromagnetic vertices considered are of two types: In the first type a quark reverses its spin direction and emits a photon. In the second type a quark-antiquark pair annihilates into a photon. (J.F.P.)

40167 APPLICATION OF HELICITY FORMALISM IN PION PHOTOPRODUCTION. Schmidt, W. (Kernforschungszentrum, Karlsruhe, Ger.); Schwiderski, G. Fortschr. Phys., 15: 393-433(1967).

The helicity formalism for meson (π) photoproduction covers the kinematics and the special choice of helicity amplitudes to be applied. The integral equations for the total helicity amplitudes are derived, and these are then projected to yield the partial amplitudes. The main result found is a general expression for the kernels K(W,W'), and this is then evaluated. Numerical results for the kernels useful in practical applications are presented. The pole term is treated separately. Formulas as well as numerical results for its contribution to the partial amplitudes are given in different approximations. To complete the application of the helicity formalism the physical observables in photoproduction are derived in terms of helicity amplitudes. (J.F.P.)

40168 IMPLICATIONS OF VECTOR-MESON FIELD THEORY AND PARTIALLY CONSERVED AXIAL-VECTOR CURRENT ON ELECTRON-POSITRON ANNIHILATION INTO HADRONS. Dooher, J. (Adelphi Univ., Garden City, N. Y.). Phys. Rev. Lett., 19: 600-3(Sept. 4, 1967).

The total cross section for electron-positron annihilation into hadrons is examined under the assumption that the hadron electromagnetic current is a linear combination of vector-meson fields. A sum rule is found which implies that the cross section must fall off faster than $E^{-4}(\ln E)^{-1}$, where E is the center-of-mass energy. (auth)

40169 GAUGE-FIELD ALGEBRA, SOFT-MESON METHODS, AND DIVERGENCES. Halpern, M. B.; Segre, G. (Univ. of California, Berkeley). Phys. Rev. Lett., 19: 611-14(Sept. 4, 1967).

Using Bjorken's methods in the context of the recently proposed gauge-field algebra of currents, the problem of divergences in electromagnetic mass differences ($m_{\pi^+}^2 - m_{\pi^0}^2$, $m_{K^+}^2 - m_{K^0}^2$) and decays, weak decays (e.g., $K_1^0 \to 2\pi$), and asymptotic behavior of electromagnetic processes are discussed. (auth)

40170 CURRENT-ALGEBRA CALCULATION OF THE CHARGED RADIATIVE η-DECAYS. Baracca, A. (Univ., Bologna); Bramon, A.; Tiemblo, A. Nuovo Cim. (10), 50A: 1006-9(Aug. 21, 1967).

The branching ratios $\Gamma(\eta \to \pi^+ + \pi^- + \pi^0 + \gamma)/\Gamma(\eta \to \pi^0 + \gamma + \gamma$ and $\Gamma(\eta \to \pi^+ + \pi^- + \gamma)/\Gamma(\eta \to \gamma + \gamma)$, the value of the latter being found to be $\simeq 0.17 \pm 0.04$, are considered. Both PCAC and PCTC are used. It was also found that current algebra and PCAC forbid the decay $\eta \to \pi^+ + \pi^- + \pi^0 + \gamma$. (J.F.P.)

40171 THE $\eta \to \pi^0 \gamma\gamma$ DECAY WITH PCAC AND PCTC. Baracca, A. (Univ., Bologna). Nuovo Cim. (10), 50A: 1010-14(Aug 21, 1967).

A similar although alternative approach to that previously used for the ratio $\Gamma(\eta \to \pi^0 + \gamma + \gamma)/\Gamma(\eta \to \gamma + \gamma)$ is used which leads directly to the width of the decay $\eta \to \pi^0 + \gamma + \gamma$. The value of the branching ratio was found to be 0.58 ± 0.12. (J.F.P.)

40172 THRESHOLD CONDITIONS FOR HELICITY AMPLITUDES. Jones, H. F. (Imperial Coll. of Science and Tech., London). Nuovo Cim. (10), 50A: 814-23(Aug. 21, 1967).

By relating the helicity coupling scheme to the l-s and multipolar schemes relations between helicity amplitudes at threshold

are derived both for massive particles and for photons; for photons the relations have to be supplemented by a low energy theorem on invariant amplitudes. In the case of πN scattering it is shown how the threshold conditions can be used to obtain kinematic-singularity-free amplitudes with improved asymptotic behavior. (auth)

40173 FINAL-STATE INTERACTIONS IN $\eta \rightarrow 3\pi$ DECAY. Smith, J. (Univ. of Adelaide). Nuovo Cim. (10), 50A: 952-6 (Aug. 21, 1967).

A combination of the effects of final-state pion-pion interactions and a matrix element linear in the energy of the neutral meson (π) in $\eta \rightarrow 3\pi$ decay is investigated using a simple nonrelativistic model. Two parameters are allowed in the matrix element. After fitting the π^0 kinetic energy spectrum, the branching ratio is found to be an algebraic expression as a function of two parameters. Since even if the PCAC predictions are wrong it is believed that the value of the branching ratio cannot be reduced to unity, thus introduction of a $\Delta I = 3$ interaction is favored (J.F.P.)

40174 DISPERSION THEORY OF THE ELASTIC PHOTON-DEUTERON SCATTERING. Pokorski, S. (Univ. of Warsaw). Nuovo Cim. (10), 50A: 957-9(Aug. 21, 1967).

The formulation of the relativistic dispersion theory of elastic $\gamma + d$ scattering is briefly sketched, and preliminary numerical results are presented. Photon-deuteron cross sections below 100 MeV are shown and compared with experiment. (J.F.P.)

40175 REMARKS ON EXCITATION FUNCTION OF THE N^*_{15} (1688). Namiki, Mikio (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 37: 1344-5(June 1967).

It is shown that the excitation function of the N^*_{15}(1688), obtained by the missing mass method in the processes $\gamma + p \rightarrow N^*$, $e + p \rightarrow e + N^*$, $p + p \rightarrow p + N^*$, and others, should be strengthened by some factor due to the existence of the doublet N^*_{15} (1688^+) and N^*_{15} (1688^-). It is concluded that the excitation function of the N^*_{15} (1688) is larger than that of the N^*_{15} (1688^+), in the absence of the N^*_{15} (1688^-), by the factor $(1 + A^2)$. (J.F.P.)

40176 PROPAGATION OF QUANTUM WAVE. GENERALIZED RANDOM PHASE APPROXIMATION. Sawada, Katuro (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto), 37: 1080-99(June 1967).

The time development of the Heisenberg operator is analyzed by separating the total system into two parts in such a way that one contains the operator and the other does not. The part which does not contain the operator is assumed to be known completely. An approximation is introduced which yields the exact excitation spectrum except for the $O(1/\Omega)$ (Ω being volume) correction of elementary excitations in lowest order. The formulation of growing wave of light is taken as an example, and it is reasonably argued that in the case where a single quantum state is occupied by finite density of quanta the approximation introduced is the expansion in terms of density of quanta. (auth)

40177 ONE-PARTICLE-EXCHANGE MODEL IN PION PHOTOPRODUCTION. I. Shimoida, Hiroo; Sumi, Yoshio; Yokomi, Hiroyuki (Osaka Univ.). Progr. Theor. Phys. (Kyoto), 37: 1167-87(June 1967).

Neutral and charged pion photoproductions above the 3-3 resonance energy are quantitatively investigated on the basis of the one-particle-exchange model. Crossing symmetry and the recently observed resonance are taken into account. Discussion of the behavior of each diagram appearing in the model is given in detail. Numerical results are compared with experiment. (auth)

40178 ABSORPTION CORRECTION IN POSITIVE PION PHOTOPRODUCTION IN GeV REGION. Hori, Setsuko; Kawaguchi, Masaaki; Shimoida, Hiroo (Osaka Univ.). Progr. Theor. Phys. (Kyoto), 37: 1188-96(June 1967).

Differential cross sections for positive pion photoproduction are calculated in the distorted wave Born approximation (DWBA) in the energy range of 1-5 GeV. Numerical results are compared with recent experiment. (auth)

40179 ANNIHILATION OF ELECTRON-POSITRON AND MUON PAIRS RESULTING FROM WEAK INTERACTIONS. Romanov, Yu. I. (Inst. of Medical Radiology, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 155-7(1967). (In Russian).

Previously it was shown that at 10^{9}K a temperature which is found in supernova bursts, the annihilation process $e^+e^- \rightarrow \nu\bar{\nu}$ is the main mechanism causing energy losses by neutrino emission. The effects of longitudinal and transverse lepton spin components on the probability processes. (1) $e^+ + e^- \rightarrow \nu + \bar{\nu}$ and (2) $\mu^+ + \mu^- \rightarrow \nu + \bar{\nu}$ were investigated and possible weak lepton interaction form factors were considered. Results of the investigations of neutrino annihilation of longitudinally polarized antileptons with polarized lepton targets (1) and (2) for the two-component and four-component theory for two neutrinos (electron ν_e and muon ν_μ) are given. (R.V.J.)

40180 INVARIANT IMBEDDING AS A BASIS FOR THE SOLUTION OF QUANTUM MECHANICAL PROBLEMS. Davies, Hugh A.; Denman, Eugene D. (Vanderbilt Univ., Nashville). J. Math. Anal. Appl., 19: 133-40(July 1967).

The invariant imbedding technique is applied to the classical potential barrier problem of quantum mechanics. The Schroedinger equation as generally used in such problems is not introduced, but the method of invariant imbedding is described and applied. The two types of equations which arise in invariant imbedding are the functional equation approach and the recursion relations. The methods are described, and both techniques are applied to the reflection and transmission of electrons incident on a potential barrier. The quantum levels of an electron in a finite potential well can be simply derived. (J.F.P.)

40181 ELECTRON-INDUCED CASCADE SHOWERS IN COPPER, TIN, AND LEAD. Crannell, Carol Jo (Stanford Univ., Calif.). Phys. Rev., 161: 310-21(Sept. 10, 1967).

Electromagnetic cascade showers induced by 900-MeV electrons were studied in copper, tin, and lead targets. A small, parallel incident beam with negligible background contamination was employed to achieve good resolution and undistorted development of the shower. The three-dimensional spatial distribution of energy deposition was measured with a CsI(Tl) detector placed at various positions in a small hole in an otherwise solid block of material. Measurements were extended to radii of 7 Molière lengths and depths of 30 or more radiation lengths. Additional data for showers induced by 200-MeV electrons incident on lead are also presented. The results of this experiment are compared with the results of previous experiments with the predictions of recent Monte Carlo calculations. The measured longitudinal distribution of energy is in good agreement with theoretical predictions, while the radial distributions show an unpredicted dependence on the atomic number of the target material. (auth)

40182 MASS NUMBER DEPENDENCE OF THE CROSS SECTION OF ELASTIC COHERENT PHOTOPRODUCTION OF NEUTRAL PIONS ON NUCLEI. Govorkov, B. B. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 6: 116-18(July 1967). (In Russian).

The result of the calculation of the $\gamma + A \rightarrow A + \pi^0$ reaction in the near-threshold energy region is that the total cross section referred to the carbon cross section has a diffraction dependence on the mass number. It approaches the $A^{2/3}$ law with the energy increasing. The calculated cross sections are in reasonable agreement with experimental results. (auth)

40183 MESON ELECTROPRODUCTION AT LARGE ANGLES AND BARYON ELECTROMAGNETIC FORM FACTORS. Rekalo, M. P. Yadern. Fiz., 6: 119-23(July 1967). (In Russian).

Meson electroproduction on nucleons is investigated at high incident electron energies and large angles between the produced meson momentum and the momentum of the virtual γ-quantum. The possibility to determine baryon electromagnetic form-factors is analyzed assuming that in the noted kinematical conditions the baryon exchange dominates. The differential cross section in the considered approximation is found to be sensitive to the baryon charge form factor. (auth)

40184 DISPERSION SUM RULES FOR THE COMPTON SCATTERING ON BARYONS. Aznauryan, I. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 6: 124-8(July 1967). (In Russian).

Sum rules for the scattering of photons on baryons are obtained from the conventional one-dimensional dispersion relations. These rules imply relations on the baryon magnetic moment and on the momenta of the radiative decays of near lying resonances. The relations obtained are in reasonable agreement with the experiment as well as with the SU(6) predictions. (auth)

Weak

Refer also to abstract 40142.

40185 (IPNO/TH-80) CURRENT ALGEBRAS AND Ω-HADRONIC DECAYS. Pham, X. Y.; Zaouri, R. (Paris Univ., Orsay (France). Institut de Physique Nucleaire). June 1967. 9p. Dep.

The parity violating as well as the parity conserving amplitudes for the decay of Ω^- into a $\frac{1}{2}^+$ baryon and a 0^- meson are discussed by using the current algebra and other technics commonly used with it. For the two pionic decay modes $\Omega^- \rightarrow \Xi^0\pi^-$ and $\Omega^- \rightarrow \Xi^-\pi^0$ the $\Delta I = \frac{1}{2}$ rule is obtained and for the $\Omega^- \rightarrow \Lambda K^-$ it is found that the D wave vanishes. Moreover an estimation $[\tau(\Omega \rightarrow \Lambda K)/(\tau\ \Omega \rightarrow$

$\Xi\pi)] \sim 1/9$ is obtained. The S waves of $\Omega^- \to \Xi^* \pi$ are related to the P waves of $\Omega^- \to \Xi\pi$. (auth)

40186 (ITF-67-4) ON EXISTENCE OF A SOLUTION OF THE BETHE–SALPETER EQUATION IN A CASE OF LEPTON INTERACTIONS. I. Yatsun, V. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1967. 37p. Dep.

The solution by a previously developed method of the integral equation for the trace of the scattering amplitude for lepton scattering via the vector meson interaction by means of the Feynman ladder diagrams is considered. The analytical properties of the solution regarded as a function of the parameter g^2 are studied. (J.F.P.)

40187 (LPTHE-TH-207) ALGEBRA OF CURRENT AND THE DEVIATION FROM THE $|\Delta I| = 1/2$ RULE IN $K \to 3\pi$ DECAY. Bouchiat, C.; Meyer, Ph. (Paris Univ., Orsay, France. Laboratoire de Physique Theorique et Hautes Energies). July 1967. 8p. Dep.

Starting from the usual current-current weak Lagrangian and using current algebra, the deviations from the $|\Delta I| = 1/2$ rule in $K \to 3\pi$ decays are determined in terms of the $K \to 2\pi$ rates. The need for better data on $K \to 2\pi$ and $K \to 3\pi$ decays is stressed in order to arrive at a possible discrimination between a fundamental or a dynamic $|\Delta I| = 1/2$ rule. As a by-product the PC conserving 3π decay of K_1^0 is calculated in the linear approximation. (auth)

40188 (NP-16949) A CONTRIBUTION OF C-NONINVARIANT γ INTERACTIONS TO THE LEPTON PAIR PRODUCTION. Kawamiya, Osamu (Kobe Univ. (Japan). Dept. of Physics). [1967]. 5p. Dep.

Corrections to the cross section of wide-angle pair production due to other processes which are different from ordinary quantum electrodynamic processes and may be appreciable at higher energy and larger momentum transfer are proposed. The vector meson case is mainly considered for $K_2^0 \to 2\pi$ decay. (J.F.P.)

40189 (NP–16978) WEAK INTERACTION OF ELEMENTARY PARTICLES. A Series of Lectures given October 1966. Nakagawa, M. (Australian National Univ., Canberra. Inst. of Advanced Studies). 97p. Dep.

The topics covered by these lectures are the concept of a weak universal interaction, the establishment of a P violating V–A law, CPT transformations and theorem, G transformation, CP violation, the concept of lepton number and its conservation, the neutrino and Pauli–Toushek transformation, the two-neutrino transformation, and μ – e universality. Also covered are CVC theory, the generalization to a unified scheme of weak interactions, the Goldberger–Trieman relation for $\pi \to \mu + \nu$ decay, interpretations of the Goldberger–Trieman relation, soft pion theory, current algebra, the Alder–Weisberger sum rule, renormalization of the strangeness-changing current, meson (K) leptonic decays, and the nonleptonic interaction. (J.F.P.)

40190 AN INTRODUCTION TO SOME RECENT WORK IN WEAK INTERACTIONS. Martin, B. R. (Univ. of Copenhagen). Fortschr. Phys., 15: 357-91(1967).

A simplified introduction to hypotheses of a conserved hadronic vector current, a partially conserved axial vector current combination with current algebra and some of the implications of these theories are presented. This review includes conserved $\Delta S = 0$ vector current hypothesis, nonconservation of the $\Delta S = 0$ axial-vector current, the Goldberger–Treiman relation and its consequences for the $\Delta S = 0$ axial-vector current, and the validity of the PCAC hypothesis for the $\Delta S = 0$ current. Also discussed are the CVC and PCAC hypotheses for the $\Delta S = 1$ current, sum rules from current algebras for the $\Delta S = 0$ currents, and SU(3) symmetry. (J.F.P.)

40191 DIVERGENCE OF WEAK CURRENTS IN THE PRESENCE OF ELECTROMAGNETIC INTERACTIONS. Kamal, A. N. (Univ. of Alberta, Edmonton). Nuovo Cim. (10), 50A: 972-5 (Aug. 21, 1967).

The Alder relations for the divergence of weak currents in the presence of electromagnetic interactions are rederived using specific radiative decay processes involving the weak vector and axial vector currents and imposing the requirement of gauge invariance on these amplitudes. The radiative decay $\pi^+ \to e^+ + \nu + \pi^0 + \gamma$ at rest is considered. (J.F.P.)

40192 $K \to 2\pi$ DECAYS AND THE $\Delta I = 1/2$ RULE. Tsai, S. Y. (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 37: 1228-38 (June 1967).

A study is given of the problem whether or not, and how, the deviations from the exact $\Delta I = 1/2$ rule observed in the $K \to 2\pi$ decays can quantitatively be explained as a consequence of electromagnetic corrections to a purely $\Delta I = 1/2$ weak interaction. A sort of the current × current type weak interaction is considered. It is shown that the experimental values of a pair of the amplitude ratios, $A(K^+ \to \pi^+\pi^0)/A(K_1^0 \to \pi^+\pi^-)$ and $A(K_1^0 \to \pi^0\pi^0)/A(K_1^0 \to \pi^+\pi^-)$, can consistently be explained from such a point of view if one considers the λ_7-like interaction, besides the usually adopted λ_8-like one, and takes the effect of the η–π^0 mixing into account. The effect of the possible vector meson intermediate states is found to be in a direction favorable for explaining these amplitude ratios if $m_{K^{*+}} - m_{K^{*0}} < 0$. The implication of the fact that the λ_7-like term plays a more important role is discussed. (auth)

40193 POLARIZATION EFFECTS IN THE PROCESSES INVOLVING HIGH ENERGY NEUTRINO. Lyul'ka, V. A. Yadern. Fiz., 6: 98-101(July 1967). (In Russian).

The polarization effects are considered in the processes induced by high energy neutrino: $\bar{\nu} + p \to Y + l^+$. The expressions are obtained for the cross sections of such reactions in the cases when an initial nucleon is polarized, and the polarization of final hyperons or leptons is measured. The contribution is taken into account from all six form factors of the strong interaction current. Some relationships are obtained between the polarization coefficients when the contribution from induced form factors or the leptonic l^+ is neglected. (auth)

40194 "TADPOLE" MECHANISM IN HADRON DECAYS AND THE CURRENT COMMUTATORS. Gedalin, E. V.; Kancheli, O. V.; Matinyan, S. G. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz., 6: 102-8(July 1967). (In Russian).

The weak hadron processes with the strangeness nonconservation ($\Delta S = 1, 2$) are considered on basis of the "tadpole" mechanism by means of current commutators. A unified description of the S-amplitudes for hadronic decays of hyperons, the $K_1^0 \to 2\pi$ decay and the K_1^0- and K_2^0-mass difference is obtained in accordance with experiment. (auth)

40195 THE $K^+ \to \pi^+ + 2\gamma$-DECAY. Vanyashin, V. S. (Dnepropetrovsk State Univ., USSR). Yadern. Fiz., 6: 109-13(July 1967). (In Russian).

The $K^+ \to \pi^+ + 2\gamma$-decay proceeding via the annihilation of the pion pair and via the virtual η-meson is considered. Its probability is found to be $2.10^{-6}\, W_{K^+}$. The $K^+ \to \pi + 2\gamma$-decay is discussed also as a background for the possible $K^+ \to \pi^+ + \nu + \bar{\nu}$-decay. (auth)

40196 RADIATION ABSORPTION OF POSITIVE MUONS BY ELECTRONS. Safronov, A. N. (Moscow State Univ.). Yadern. Fiz., 6: 114-15(July 1967). (In Russian).

It is shown that brehmsstrahlung photons following the two neutrino $\mu + e^-$ annihilation have an essential influence over it. (auth)

Strong (General)

40197 (NP–16941) RADIATIVE CORRECTIONS TO LEPTONIC DECAYS AND COMPOSITE MODELS FOR STRONG INTERACTIONS. Internal Note No. 127. Cabibbo, N.; Maiani, L.; Preparata, G. (Rome Univ. (Italy). Istituto di Fisica). June 19, 1967. 10p. Dep.

On the basis of the requirement of finite radiative corrections for leptonic decays, the abandonment of the quark model for strong interactions, in favor of models based on integrally charged triplets is proposed. A model of this kind—the SUB model—is discussed. This model is based on a proposal of Han and Nambu in which most of the results of the nonrelativistic quark model hold. (auth)

40198 COMPLEX-ANALYTICAL HADRON PHYSICS. Kuti, Gyula (Lorand Eotvos Univ., Budapest). Fiz. Szemle, 17: 168-79(June 1967). (In Hungarian).

There are four basic interactions which govern all processes in nature. Among these is the strong interaction. The particles involved in these interactions are not well understood, even though the number of newly discovered particles keeps increasing, having reached about 200 by 1966. Two directions emerge at present in the theoretical studies in this area: the partisans of the field theory attempt to develop a macroscopic field approach, while the S-matrix physicists are against the examination of small space-time segments and try to develop a theory based on experimental situations. In strong interaction processes, the scattering of hadrons is considered. The main principle of the S-matrix theory is that the matrix elements are analytical functions of the particle energies and impulses. The bootstrap dynamism represents a further development of the S-matrix: it assumes that all interacting particles are equivalent dynamic products, built from each other and the forces creating the bond are produced by the interchange of the particles in the scattering amplitude. There are still many unanswered questions in the analytical S-matrix theory. (TTT)

40199 REGGEIZATION OF PARTICLES WITH IDENTICAL QUANTUM NUMBERS. Konisi, Gaku; Saito, Takesi (Kwansei Gakuin Univ., Nishinomiya, Japan). Progr. Theor. Phys. (Kyoto), 37: 1304-13(June 1967).

It is shown that when several particles with identical quantum numbers are present, they are either all elementary particles, or all Regge particles, i.e. a mixing of elementary particles and Regge particles does not occur. (auth)

40200 QUARK MODEL WITH THE REGGE POLE AMPLITUDE FOR HIGH ENERGY FORWARD SCATTERING. Motoyoshi, Akio (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 37: 1254-67(June 1967).

It is shown that hadron-hadron scattering amplitudes for elastic, charge exchange and quasi-two-body processes at high energies and small momentum transfer can well be described, in a simple and unified way, by the Regge pole amplitudes for quasi-free quark-quark scattering. A model which separates the s- and t-dependence of the scattering amplitude is considered. To reduce the number of free parameters, the exchange degeneracy hypothesis is assumed. It seems that this hypothesis is valid with fairly good accuracy. In various relations among hadron-hadron total cross sections, only the weaker form of the Johnson-Treiman relation survives in this model. To explain the experimental data on σ_T, $d\sigma/dt$ and Re T/Im T the value of effective quark mass is taken as considerably small. Quasi-two-body processes are treated simply by consideration of spin flip in quark level, and the selection rule $\langle B^*p|\pi^+p\rangle = 0$ is obtained. (auth)

40201 S-MATRIX THEORY OF FINAL-STATE INTERACTIONS. Graves-Morris, P. R. (Cambridge Univ., Eng.). Nuovo Cim. (10), 50A: 681-700(Aug. 21, 1967).

Some recent equations for final-state interactions based on the explicit insertion of unitarity singularities in an on-mass-shell analytic S-matrix theory are considered. Numerical solutions for the model case of spinless particles are given. This forms the framework for a discussion of the expected magnitudes of multiple-rescattering effects, which are of topical interest. The equations are straigthforward numerically, and comparison of the results shows the features which are independent of the details of the individual theories. (auth)

40202 ON THE QUESTION OF ADEQUACY OF THE N/D METHOD IN MASS-SHIFT CALCULATIONS. Banerjee, H. (Saha Inst. of Nuclear Physics, Calcutta). Nuovo Cim. (10), 50A: 992-6(Aug. 21, 1967).

It is found that the origin of the anomalous result in the N/D approximation can be traced precisely to the violation of the condition that no ghosts appear in the theory previously considered by Sawyer for the adequacy of the N/D method in mass-shift calculations; that is, if the no-ghost condition is introduced as an input constraint of the theory the N/D result for the response in the models considered by Sawyer must necessarily be positive. It is concluded that the previous diagnosis of the problem in the N/D method, at least within the context of the extended Lee model considered, is misplaced, and the reasons for deciding against the use of the N/D method for calculating mass shifts of hadrons are unjustified. (J.F.P.)

40203 COLLINEAR PROCESSES IN THE QUARK MODEL. Malyuta, Yu. M. (Inst. of Physics, Kiev). Ann. Phys. (N.Y.), 44: 35-56(Aug. 1967).

A quark model of hadrons is proposed, based on the collinear group SU(3) × SU(3) × ... × SU(3) (2j + 1 cofactors). Relations are found within the framework of this model for the partial widths of meson and baryon resonances, as well as relations for the total and differential cross sections of a number of elastic and inelastic scattering processes. (auth)

40204 SINGULARITIES OF SQUARE GRAPHS WITH RESONANCES IN THE INTERMEDIATE STATE. Anisovich, V. V. Yadern. Fiz., 6: 146-52(July 1967). (In Russian).

Analytical properties of the square graph with two resonances in the intermediate state are considered. This graph is shown to have root singularity in the denominator that is near the physical region of the reaction when W ≥ 21 (W-total energy of the system, 1-mass of the resonance). A descriptive kinematical rule to find the position of this singularity is given. (auth)

40205 DETERMINATION OF SPIN AND PARITY OF THREE-PARTICLE RESONANCES. Dubovikov, M. S. (Moscow Physical-Technical Inst.). Yadern. Fiz., 6: 178-85(July 1967). (In Russian).

The formulas for the experimental determination of the spin and parity of the three-particle resonances decaying according to the scheme j → s + 0 + 0 are obtained on the basis of the properties of three-particle decay amplitudes found by Bermann and Jacob. The formulas are presented for the particular cases: 1 → 0 + 0 + 0; 2 → 0 + 0 + 0; ½ → ½ + 0 + 0; ³/₂ → ½ + 0 + 0. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 40203.

40206 (CERN-67-18) THE K^0anti K^0 SYSTEM. Lectures Delivered at Matscience Institute, Madras, India, December 1966 and January 1967. Charpak, G. (European Organization for Nuclear Research, Geneva (Switzerland); Gourdin, M. (Paris Univ., Orsay (France). Faculte des Sciences). July 11, 1967. 104p. Dep.

A review of the most important facts in neutral meson (K) physics is given, with only the most recent experiments considered. The theoretical significance and results of these experiments are discussed in detail. The $K^0\overline{K}^0$ system under the assumption of PC invariance, decay modes and selection rules in meson (K) decay, recent experiments in neutral meson (K) physics, the sign of Δm, and interference experiments in the 2π decay of K_S and K_L are covered. Also covered are strong electromagnetic, and weak interactions, discrete symmetries, unitarity conditions, the violation of PC invariance, isotropic spin analysis, CPT invariance, and time reversal invariance. (J.F.P.)

40207 (UCRL-17696) QUANTUM NUMBERS OF BOSON RESONANCES. Goldhaber, Gerson (California Univ., Berkeley. Lawrence Radiation Lab.). July 1967. Contract W-7405-eng-48. 93p. Dep. CFSTI.

A series of lectures presented at the 1967 CERN School of Physics on boson resonances are presented, with emphasis on new data obtained since the 1966 Berkeley conference. A brief survey is first presented on the established boson nonets-the $J^P = 0^-$, $J^P = 1^-$, and $J^P = 2^+$ nonets. Experimental data which give evidence of other boson nonets are presented and discussed in the next lecture. The experimental consequences of the $q\bar{q}$ model for boson L clusters are explored in the third lecture. Two appendices are included. In the first a new method is described for the utilization of the Dalitz plot designed to facilitate the search for new resonances and the determination of their quantum numbers for three-particle resonances. Tables of allowed and forbidden two-body decay modes are presented in the second. (L.B.S.)

40208 PRESENT STATE OF THE QUARK EXPERIMENTS. Appel, H.; Goerres, J. (Kernforschungszentrum, Karlsruhe, Ger.). Phys. Bl., 22: 542-55(1966). (In German). (KFK-538).

The properties of quark particles that can be used in their detection (mass, charge, and stability) are outlined. The detection principles used in the experimental studies are reviewed. The most important experiment for the detection of free quark particles are outlined. These can be divided into three sections: experiments on accelerators, experiments using cosmic radiation, and utilization of the stability of the quark. (J.S.R.)

40209 TWO-BODY BOUND PROBLEM OF DIRAC PARTICLES. Koide, Yoshio; Yamada, Eiji (Kanazawa Univ., Japan). Progr. Theor. Phys. (Kyoto), 37: 1337-40(June 1967).

The problem of the mass levels of mesons is studied from a slightly different point of view from that previously used on the basis of the composite model and using the Schrödinger equations. The model of Dirac particles interacting through potential is assumed, and it is concluded that if there is a mass difference between the constituents, the mass of a composite particle cannot be smaller than $M \equiv (m_1 + m_2)/2$, where m_1 and m_2 and the masses of the constituents, except for the $^1S_0$ state. (J.F.P.)

40210 CONSTRUCTIVE FORCE OF THE COMPOSITE SYSTEM. Maekawa, Takayoshi (Kumamoto Univ., Japan). Progr. Theor. Phys. (Kyoto), 37: 1268-85(June 1967).

In order to see whether the constructive force of the composite systems can be obtained along the line of thought of the intermediary vector boson, it is examined by using the field-theoretical technique whether the mass of an urbaryon-anti-urbaryon system can be obtained consistently or not; it is assumed that the constructive force between the urbaryon and anti-urbaryon is brought about by a vector boson and that the origin of the mass difference of the composite mesons is of the well-known T_3^1 type. The result is that it seems impossible to realize consistently the masses of both spin singlet and triplet mesons by means of one kind of vector boson, and it seems impossible to obtain consistently the masses of the π, K, η, and x mesons even if there exist both U(3) octet and singlet bosons, but it is possible to obtain the masses of the p, K^*, φ, and ω mesons if the vector boson is a U(3) singlet. (auth)

40211 SUPERCONVERGENCE CONDITION AND OKUBO'S ANSATZ. Matsuda, Satoshi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 37: 1286-90(June 1967).

Possible superconvergence relations for pseudoscalar-meson-vector-meson(P-V) scattering are investigated within the framework of SU(3) symmetry. It is shown that Okubo's "ansatz" for the VVP-coupling can be justified from the most convergent one among the superconvergence relations. (auth)

40212 SOME REMARKS ON THE PION–PION SCATTERING LENGTHS IN THE I = 0 AND I = 2 STATES. Kretzschmar, M. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cim. (10), 50A: 976-83(Aug. 21, 1967).

Some further theoretical arguments based on a Reggeized strip approximation to the Mandelstam representation for the meson (π)–meson (π) scattering amplitude as described previously are presented. Within this theoretical framework the considerations definitely predict positive scattering lengths both for I = 0 and I = 2 S-waves, and for rather general reasons these considerations make negative scattering lengths difficult to understand. (J.F.P.)

40213 TWO-CHANNEL MODEL OF THE π-MESON. Hayashi, K.; Seto, N. (Kyoto Univ.). Nuovo Cim. (10), 50A: 804-13 13(Aug. 21, 1967).

The pion model in terms of the two channels, $\rho\pi + N\bar{N}$ is discussed, employing a matrix N/D technique with pole approximation to the left-hand-cut contributions. The inclusion of the annihilation channel is shown to be of great importance. The dissociation probability of the pion into the $N\bar{N}$ state will be expected to be fairly small as compared with that into the $\rho\pi$ mode when the force in this channel is of the same order of magnitude as those in the elastic channels. (auth)

40214 LIMITATION ON THE USE OF CURRENT ALGEBRA TECHNIQUES FOR MESON DECAYS. Kellett, B. H. (Imperial Coll. of Science and Tech., London). Nuovo Cim. (10), 50A: 768-75(Aug. 21, 1967).

It is shown that for decays involving only 1^- particles and an odd number of 0^- particles, the current algebra approach is not useful. (auth)

40215 DETERMINATION OF REGGE TRAJECTORIES IN A BOOTSTRAP MODEL OF PION–PION SCATTERING. Mueller, Harald J. W. (Univ., Munich, American Univ. of Beirut). Z. Phys., 205: 145-8(1967).

A simple expansion is used for calculating the zero-energy intercepts of the leading Regge trajectories of the pion-pion scattering amplitude. The results agree well with those of other determinations. (auth)

Strong (Baryon No. = 1)

Refer also to abstract 40203.

40216 (CERN–67-20) ON DETERMINATION OF SPIN, DECAY PARAMETERS, AND DENSITY MATRIX OF DECAYING STATES. Byers, N. (European Organization for Nuclear Research, Geneva (Switzerland)). Aug. 18, 1967. 48p. Dep.

Decay sequences such as $X \to \Lambda + K$, $\Lambda \to p + \pi$, where X represents a particle with spin J, and K represents particles with spins one-half and zero, respectively, and the decay $\Lambda \to p + \pi$ serves to measure the polarization of Λ are discussed in detail. It is shown how angular correlations in this equation exhibit the spin, spin orientation (density matrix), and decay amplitudes of X. (J.F.P.)

40217 (JINR-P1-3416) FAZOVYI ANALIZ PION-NUKLONNOGO RASSEYANIYA PRI ENERGII 310 MeV S PRIVLECHENIEM DANNYKH PO POLYARIZATSII NEITRONOV OTDACHI. (Phase Shift Analysis of 310 MeV π–N Scattering Using the Recoil Neutron Polarization Data). Vasilevskii, I. M.; Vishnyakov, V. V.; Ivanchenko, I. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 6p. (In Russian). Dep.

The SPDE–phase-shift analysis of all available data on π-N scattering at 310 MeV was carried out. It is shown that the Vik and Rugge set I does not satisfy the experimentally measured value of recoil neutron polarization from the process of negative pions charge exchange by protons. (auth)

40218 (NP–16952) NOVYE DANNYE O REAKTSIYAKH PRI VYSOKOI ENERGII (LEKTSIYA V SHKOLE FIZIKI V G. EREVANE, KH. 1966 G.). (New Data on High-Energy Reactions. Lecture at the School of Physics in Yerevan, October 1966). No. 494. Ter-Martirosyan, K. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1967. 53p. (In Russian). Dep.

Results of the complex momenta theory, in particular of the Regge pole model, are compared with the experimental data on the high energy particle interactions obtained mainly during the last year. The data on the total cross sections, on the elastic scattering cross sections in the diffraction region, and on the simplest inelastic processes are in good agreement with the model of several Regge poles. Use of these data makes it possible to determine the parameters in theoretical formulas and to make extrapolations into the region of very high energies. Trajectories ρ and A_2 are determined by the data on the cross sections of charge exchange reactions $\pi^-p \to \pi^0n$ and of production $\pi^-p \to \eta^0n$ and are in good agreement with the result of the Maglic group on boson resonances. Experimental data on the cross section charge exchange reactions of K-mesons and nucleons are discussed. Determination of the energy dependence of cross sections of these processes in the region 30–100 GeV may be of great importance to proof or disproof the main statements of the theory. A great number of the data on the production of various resonances in $\pi^\pm p$, $K^\pm p$ and NN collisions recently obtained experimentally are in good agreement with the theory. In conclusion, the question is considered for πN-backward scattering in the region up to 8 GeV where the interference effects of the Regge amplitude with S-channel resonant scattering are still considerable. (auth)

40219 (UCRL-17682) MODEL FOR THE DECAY $\Sigma(1660) \to \Sigma\pi\pi$. Eberhard, Philippe; Pripstein, Morris (California Univ., Berkeley. Lawrence Radiation Lab.). July 17, 1967. Contract W-7405-eng-48. 10p. Dep. CFSTI.

An explicit calculation of the probability distributions of the particles $\Sigma\pi\pi$ from $\Sigma(1660)$ decay was performed. The model for the decay process is described and the result of the computation is given. (auth)

40220 THE K^- MESON-PROTON INTERACTION AT LOW ENERGIES. Otter, G. (Institut fuer Hochenergiephysik, Vienna). Fortschr. Phys., 15: 333-56(1967).

A review of the theory for meson (K^-)–proton interactions at low energies is given. The development of the theory includes discussions of the Schrödinger equation in the multichannel system and the T-, K-, and S-matrices, scattering length, zero-range, and effective-range theories, resonance in the two-channel system, and an application to the meson (K^-)–proton S-wave interaction. The meson (K^-)–proton S-wave and meson ($\bar{K}^0$)–proton interactions are also considered. (J.F.P.)

40221 SU(3), MESON–BARYON SCATTERING, AND ASYMPTOTIC LIMITS. Meshkov, S. (National Bureau of Standards, Washington, D. C.); Yodh, G. B. Phys. Rev. Lett., 19: 603-8 (Sept. 4, 1967).

The meson-baryon total cross sections and elastic-scattering data in the forward direction are fitted using SU(3)-invariant t-channel amplitudes. The analysis implies that (1) $0 \leq \sigma_{tot}(s \to \infty) \leq 15.5$ mb, and (2) $-0.11 \leq \mathrm{ReT}(s,t=0)/\mathrm{ImT}(s,t=0) \leq 0$ as $s \to \infty$. (auth)

40222 SHRINKING NATURE OF DIFFRACTION AMPLITUDES DUE TO PERIPHERAL INELASTIC PROCESSES. Ino, T.; Kikugawa, M.; Yonezawa, M. (Hiroshima Univ.). Nuovo Cim. (10), 50A: 960-2(Aug. 21, 1967).

An intuitive discussion on the shrinking nature due to the one-meson-exchange-dominated inelastic process which is behind the discussions of the nature of the diffraction scattering in connection with the Regge-type behavior of the scattering amplitude at high energies is given. In order to examine the magnitude of the shrinkage due to this mechanism, the diffraction due to the inelastic processes $K^+ + p \to K^* + p$ and $p + p \to N^*_{33} + p$ in the spinless model are calculated. (J.F.P.)

40223 ISOBARIC SATURATION OF THE ADLER–WEISBERGER SUM RULE. Selva, A. Della; Masperi, L. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim. (10), 50A: 997-9(Aug. 21, 1967).

A verification is made of how the approximation of partial saturation of sum rules, when one inserts a finite number of resonances as intermediate states, works in the case of a well-established sum rule, that of Adler–Weisberger when an attempt is made to saturate it with nucleon resonances. (J.F.P.)

40224 CURRENT-DIVERGENCE COMMUTATOR. Capra, F. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cim. (10), 50A: 984-8(Aug. 21, 1967).

A calculation of the equal-time commutator of an axial current and an axial divergence is given with the help of a low-energy theorem involving the symmetric part of the meson (π)–nucleon scattering amplitude. The result is compared with the σ-model, and a relation between the mass of the σ–meson and the σ-nucleon coupling constant and the form factor of the $NN\sigma$ vertex is derived. The interactions $\pi^+ + p$ and $\pi^- + p$ are considered. (J.F.P.)

40225 REGGE-POLE MODEL FOR A_2-MESON PRODUCTION. Sundaram, A.; Sridhar, R. (MATSCIENCE, Madras). Nuovo Cim. (10), 50A: 969-71(Aug. 21, 1967).

The cross section for the process $\pi^+ + p \rightarrow A_2^+ + p(A_2^+ J = 2^+$, mass 1310 MeV) was studied using a simple Regge pole model, and the dependence of the cross section on t and s is found to be in reasonable agreement with experiment. The process studied goes via ρ exchange, and the parameters of the meson (ρ) trajectory are well determined in the analysis of $\pi^- + p$ charge exchange scattering. The predictions of the Regge pole model as compared with experiment and also with the results of the absorption model are shown. Also the values obtained for the total cross section at 4 and 6 GeV/c are tabulated. (J.F.P.)

40226 REGGE-POLE PARAMETERS FOR THE REACTION $\pi^+ + p \rightarrow \pi^0 + \Delta^{++}(1238)$. Krammer, M.; Maor, U. (CERN, Geneva). Nuovo Cim. (10), 50A: 963-8(Aug. 21, 1967).

It is pointed out that the whole of the available experimental data on the reaction $\pi^+ + p \rightarrow \pi^0 + \Delta^{++}(1238)$ in the GeV region can be fitted rather well assuming a simple Regge pole model. The treatment differs from previous attempts in that the parametrization factors out explicitly all kinematic singularities and threshold behavior from the residue functions, and also the attempted fit is made for the energy and momentum-transfer dependence of the cross sections as well as for the polarization properties of the produced Δ^{++} isobar. (J.F.P.)

40227 SUM RULE FOR THE REAL PART OF ANY ELASTIC OR INELASTIC AMPLITUDES FROM CURRENT ALGEBRA. Sankaranarayan, D. (Tata Inst. of Fundamental Research, Bombay). Nuovo Cim. (10), 50A: 884-93(Aug. 21, 1967).

Using current algebra and the hypothesis of partially conserved axial vector current, a sum rule was obtained for the real part of any elastic or inelastic amplitude. The derivation of the sum rule is noncovariant in the sense that the sum rule is obtained in an infinite momentum frame and it is similar in spirit to one Adler's noncovariant derivations of the sum rule for axial vector coupling constant. Applying the sum rule, the ratio of the real part to the imaginary part of the π^+p and K^+p forward scattering amplitudes at high energies are evaluated. This ratio is obtained in terms of the renormalized axial vector coupling constant, the appropriate total cross section and a strong coupling constant, and the results are compared with experiment. (auth)

40228 PION–NUCLEON VERTEX FOR A BARYON RESONANCE OF ARBITRARY SPIN. Raszillier, I. (Inst. of Physics, Bucharest); Schiller, D. H. Nuovo Cim. (10), 50A: 741-8 (Aug. 21, 1967).

The general expressions of the pion-nucleon-$\mathcal{N}^{j+\frac{1}{2}}$ vertices, for baryon resonances $\mathcal{N}^{j+\frac{1}{2}}$ of arbitrary spin $(j + \frac{1}{2})$ described by Rarita-Schwinger fields are given. The form factors are expressed in terms of the pion-nucleon scattering phase shifts. (auth)

40229 PRODUCTION AND DECAY OF DECUPLET BARYON RESONANCES AND BROKEN $U_{6,6}$ SYMMETRY. King, R. C. (Univ. of Southampton, Eng.). Nuovo Cim. (10), 50A: 719-40 (Aug. 21, 1967).

Covariant projection formulas are given which enable the spin density matrix elements for a spin-$\frac{3}{2}$ particle to be calculated from a knowledge of the matrix element governing the production of such a particle together with a spin-zero particle in the scattering of a spin-zero particle by a spin-$\frac{1}{2}$ particle. Use is made of these formulas to calculate the differential cross section for a number of such production processes assuming that the matrix element is determined by a $U_{6,6}$-invariant four-point function. The consequences of adopting a single-particle exchange model with $U_{6,6}$-invariant vertex functions and, more generally, of including momentum spurions to all orders, are also determined. It is found that in four experimentally accessible processes the decay distribution of the spin-$\frac{3}{2}$ particle is uniquely predicted, in all these models, to be the Sakurai-Stodolsky distribution. This is not true for a similar set of models based on $SI_{4,C}$. (auth)

40230 DERIVATIVE COUPLING MESON THEORY AND PCAC. Ishida, Kin-ichi; Takahashi, Atsushi (Yamagata Univ., Japan). Progr. Theor. Phys. (Kyoto), 37: 1342-4(June 1967).

The low-energy $\pi + N$ scattering is investigated by using derivative coupling meson theory and PCAC. It is found that this low-energy $\pi + N$ scattering theory can naturally be interpreted as derivative coupling theory with the consideration of the ρ-exchange interaction. The differences obtained between the p-wave scattering lengths are given. (J.F.P.)

40231 CURRENT COMMUTATION RELATION AND PION–NUCLEON SCATTERING. Ishida, Kin-ichi; Takahashi, Atsushi (Yamagata Univ., Japan). Progr. Theor. Phys. (Kyoto), 37: 1340-2(June 1967).

The p-wave scattering amplitudes at low energies are investigated by using PCAC and current commutation relations. Relations for the p-wave scattering lengths are obtained and given. (J.F.P.)

40232 SUM RULES FOR PARTIAL-WAVE AMPLITUDES. Igi, Keiji (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 37: 1197-1201(June 1967).

The superconvergence relations for pion-nucleon partial-wave amplitudes are obtained. The study of singularities on unphysical cuts enables one to obtain the width and position of a resonance. The (33)-resonance is discussed as an example. (auth)

40233 DISPERSION SUM RULES FOR πp^- AND Kp-SCATTERING. Zhuravlev, V. I.; Rerikh, K. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 6: 165-9(July 1967). (In Russian).

The dispersion sum rules connecting the high-energy scattering parameters with the integrals of low-energy cross sections are analyzed. (auth)

40234 ON POLARIZATION EFFECTS IN VECTOR MESON PRODUCTION IN πN-COLLISIONS AT HIGH ENERGY. Karnakov, B. M.; Nikitin, Yu. P. (Moscow Engineering-Physics Inst.). Yadern. Fiz., 6: 170-3(July 1967). (In Russian).

The vector meson production in πN-collisions at high energy and small momentum transfer are considered. The relationships between the partial waves of the annihilation t channel at $t = 0$ are obtained on the basis of the analyticity of production amplitude. Possible form of the amplitude and polarization density matrix of the ω-meson produced at small momentum transfer $|t| \ll m^2$ is discussed. (auth)

Strong (Baryon No. ≥ 2)

40235 (LPTHE-TH-209) NONRELATIVISTIC SUM RULES AND THE BINDING ENERGY OF THE DEUTERON. Chadan, K.; Montes Lozano, A. (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). July 1967. 16p. Dep.

Nonrelativistic sum rules in potential scattering with potentials of finite radius are used to calculate in a very simple way the deuteron binding energy from neutron-proton triplet-S phase-shift. In order to use these sum rules, the imaginary zeros in the k-plane ($k = \sqrt{E}$), of the regular solution $\varphi_l(k,r)$ of the radial Schrödinger equation are studied in detail for an arbitrary potential (whether having a finite radius or not), and their properties are established. It is found that these zeros are closely related to the bound states. In particular, their number is the same as the number of bound states. If the zeros are denoted by $i\gamma_j(r)$, $j = 1, \ldots n$, it can be shown that each $\gamma_j(r)$ is an increasing function of r, and has a finite limit for $r \rightarrow \infty$, which corresponds to a bound state of energy $E_j = -\gamma_j^2(\infty)$. These facts, together with the sum rules, enable the bound state energies to be calculated in a very simple and direct manner from the phase-shift and the interaction radius, which is an arbitrary parameter in the sum rules and may be chosen as large as necessary in order to be sure that one is really outside the range of the interaction. The method is applied to the deuteron, assuming that the n-p interaction in $^3S_1$ state has a radius of the order of the triplet scattering length ($a_t = 5.4$ fermi), i.e., more than three times the triplet effective range ($r_{ot} = 1.73$ fermi). The result is 2.30 MeV, in good agreement with the experimental value 2.224 MeV. This particular example shows that, although, in general, the phase-shift and the binding energies are, except for the Levinson theorem, independent of each other, it may be possible, for interactions of short range, to calculate the latter from the former in a simple way by making the physically reasonable assumption that the interaction vanishes identically beyond some radius, which may be taken as large as necessary. Some possible applications of the sum rules are briefly indicated at the end. (auth)

40236 ONE-PION-EXCHANGE CONTRIBUTION IN THE $\Lambda-N$ INTERACTION. Machida, Shigeru (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 37: 1202-10(June 1967).

The one-pion-exchange contribution to the $\Lambda-N$ interaction is investigated. This is expected to be appropriate for investigation of the violation of the charge independence in the strong interaction, because this contribution has a long force range, which is twice as large as that of the charge independent interaction, and moreover has an unambiguous functional form, the strength of which is of equal magnitude and of opposite sign for the Λp and Λn interactions. Effects of this interaction on the scattering lengths and effective ranges for singlet and triplet S states are evaluated for typical values of the parameters. Results are given. (auth)

40237 IMPACT-PARAMETER REPRESENTATION FOR PROTON–PROTON HELICITY AMPLITUDES AT HIGH ENERGIES. Kubo, Reijiro (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 37: 1211-27(June 1967).

Proton-proton scattering at high energies (5 ~ 20 GeV/c laboratory momentum) is investigated by taking into account the spins of protons. It is shown that the Jakob-Wick helicity amplitudes are

still useful in such a high-energy region, if one makes use of the impact-parameter expansion for them. The unitarity conditions for the helicity amplitudes are briefly discussed. A simple model is proposed and comparison with the p-p data is made. (auth)

40238 STUDIES OF NUCLEAR AND ELEMENTARY PARTICLE PHYSICS WITH HYPERNUCLEI. Ali, Shamsher (Atomic Energy Centre, Dacca, Pakistan). Nucl. Sci. Appl., 2: No. 2, 32-7(Oct. 1966).

Analysis of hypernuclei on the basis of their binding energies gives extremely useful information about the nature of $\Lambda-N$ interaction and provides an excellent probe for investigating some nuclear physics problems of light nuclei. All these are discussed in detail. (auth)

40239 EFFECTS OF THREE-BODY ΛNN FORCES IN LIGHT HYPERNUCLEI. Bhaduri, R. K.; Loiseau, B. A.; Nogami, Y. (McMaster Univ., Hamilton, Ont.). Ann. Phys. (N.Y.), 44: 57-73 (Aug. 1967).

Effects of the two-pion-exchange ΛNN force on the binding energies of $^{5}_{\Lambda}$He and $^{3}_{\Lambda}$H are examined in detail. This ΛNN force W consists of two parts: $W = W_p + W_s$, where W_p and W_s are due to the p-wave and s-wave $\pi-\Lambda$ interaction, respectively. For W_p, the effect of Y_1^* (1385) is also taken into account. For W_s, a suppression factor of the s-wave $\pi-\Lambda$ interaction is introduced in analogy to the $\pi-N$ case. Since the short-range part of the ΛNN force is not known, a cutoff radius d is introduced and W is set to be zero for ΛN distances less than d. The effect of W_p in $^{5}_{\Lambda}$He is found to be repulsive and quite appreciable. For instance, for d = 1F, it reduces the binding energy of $^{5}_{\Lambda}$He by about 2 MeV. This results in a substantial reduction in the overbinding of $^{5}_{\Lambda}$He that was obtained when only a two-body ΛN force was used that fitted Alexander et al.'s low-energy scattering parameters. Bulk of this contribution comes from the "tensor part" of W_p which has been ignored in previous works. W_s is unimportant provided the s-wave suppression factor is 10 or more. The ΛNN force plays only a minor role in $^{3}_{\Lambda}$H. (auth)

40240 ABSORPTION MODEL AND FORM FACTORS. Graves-Morris, P. R. (Univ. of Kent, Canterbury, Eng.). Nuovo Cim. (10), 50A: 989-91(Aug. 21, 1967).

The effect of introducing an exponential damping factor into a spinless model is considered. It is proven that the exponential damping factor leads to amplitudes given by the use of a heuristic form factor. Numerical agreement confirms this statement in the case of $\bar{p} + p$ interactions. (J.F.P.)

40241 COHERENT BREAK-UP OF THE DEUTERON AND THE PHASE OF HIGH-ENERGY AMPLITUDES. Bertocchi, L. (CERN, Geneva). Nuovo Cim. (10), 50A: 1015-21(Aug. 21, 1967).

It is pointed out that the interference between single- and double-scattering amplitudes is not limited to the elastic scattering in which the target nucleus remains in the fundamental state, but occurs also in phenomena in which the target breaks up into non-relativistic components inasmuch as all the independent variables in the final configuration are measured; then by varying the values of some kinematic variables in the final state one correspondingly changes the position of the evential dip in a continuous way. The case of the deuteron breakup $x + d \rightarrow x' + p + n$ is discussed neglecting all complications connected with spin variables. (J.F.P.)

40242 REFINEMENT OF THE PHASE ANALYSIS OF NN-SCATTERING AT THE ENERGY 147 MeV. Kazarinov, Yu. M.; Legar, F.; Yanout, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 6: 174-7(July 1967). (In Russian).

The refinement of the phase analysis of NN scattering at the energy 147 MeV is made with the use of all available data at close energies. The experimental results for the np- and pp-scattering effective cross section and pp-scattering polarization were normalized to the energy 147 MeV. (auth)

40243 ON BEHAVIOR OF AMPLITUDES OF NUCLEAR REACTIONS NEAR SINGULARITIES OF THE TRIANGULAR FEYNMAN GRAPHS. Dal'karov, O. D. Yadern. Fiz., 6: 77-83(July 1967). (In Russian).

The contribution to the amplitudes of the reactions $\pi^+ + d \rightarrow p + p$ (2) and $p + d \rightarrow p + X$ near singularities of nonrelativistic triangular graphs is considered. The calculated total cross section of the reaction (2) and effective mass (m_N) distributions are compared with experimental data. (auth)

40244 CALCULATION OF THE DOUBLE CHARGE EXCHANGE OF π-MESONS ON NUCLEI. Batusov, Yu. A.; Kochkin, V. I.; Mal'tsev, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 6: 158-64(July 1967). (In Russian).

The total double-charge exchange cross section for photoemulsion nuclear is calculated in the primary meson energy range 50 to 300 MeV in terms of the cascade model for the π-meson interaction with a nucleus by using the Monte Carlo method. The cross section dependence on the nuclear atomic number is obtained; the energy and angular distributions of secondary mesons are calculated. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 40266.

40245 COMPLEX CHARGE AND BINDING OF QUARKS. Krolikowski, W. (Inst. for Nuclear Research, Warsaw. Univ. of Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 15: 363-7(1967).

The concept of a complex charge is introduced to provide binding of three quarks in s states. The system of three quarks is the smallest quark system that can be "neutral" with respect to this charge. Two fundamental questions arise in this three-triplet quark model: which quantum numbers infer the difference between three triplets (or between three states of the same triplet) and why only three quarks belonging to three different triplets can form comparatively stable baryon states. These questions are answered by postulating the existence of a new charge Z with the following properties: (1) the Z charge has three smallest eigenvalues z_i (i = 1, 2, 3) of the same absolute value; (2) the sum of the eigenvalues z_i is zero; and (3) the Z charge is the source of a neutral vector meson X. Some remarks are added on the formal construction of the operator for the Z charge by means of some generators of an SU(3) group. (L.B.S.)

40246 LINEAR FIELD EQUATIONS FOR PARTICLES WITH ARBITRARY SPIN. Castell, L. (IAEA, Trieste, Italy). Nuovo Cim. (10), 50A: 945-51(Aug. 21, 1967).

It is shown how one can specify a certain class of linear Lorentz-invariant field equations by a sequence of different Lie algebras. Within this framework the Lie algebra of $SO_{3,2}$ is particularly important for physical applications. (auth)

40247 EIGENFUNCTION EXPANSIONS ASSOCIATED WITH THE SECOND-ORDER INVARIANT OPERATOR ON HYPERBOLOIDS AND CONES. III. Limic, N.; Niederle, J.; Raczka, R. (International Center for Theoretical Physics, Trieste, Italy). J. Math. Phys. (N. Y.), 8: 1079-93(May 1967).

The eigenfunction expansions associated with the second-order invariant operator on hyperboloids and cones are derived. The global unitary irreducible representations of the $SO_0(p,q)$ groups related to hyperboloids and cones are obtained. The decomposition of the quasi-regular representations into the irreducible ones is given and the connection with the Mautner theorem and nuclear spectral theory is discussed. (auth)

40248 BARGMANN–WIGNER EQUATIONS. Critchfield, Charles L. (Los Alamos Scientific Lab., N. Mex.). J. Math. Phys. (N. Y.), 8: 1037-9(May 1967). (LA-DC-7803).

The redundancy of the Bargmann–Wigner equation for free particles of spin S greater than one-half is analyzed. Only $2(2S + 1)$ equations involve an essential time derivative, as is well known. An additional $\frac{1}{3}(S + 3)(4S^2 - 1)$ is required to define all components of the representation. The remaining $(S + 1)(4S^2 - 1)$ are time derivatives and divergence conditions; the latter occurring doubly. (auth)

40249 SYMMETRIES OF THE BETHE–SALPETER EQUATION FOR RELATIVISTIC BOUND-STATE PROBLEM. Biswas, S. N. (Univ. of California, Los Angeles). J. Math. Phys. (N. Y.), 8: 1109-11(May 1967).

Possible dynamical symmetries of the Bethe–Salpeter equation in the ladder approximation for the bound state of two neutral scalar mesons interacting via a massless scalar boson were investigated. It is shown that the Bethe–Salpeter equation exhibits an O(5) or O(4) symmetry according as E, the total energy of the system, is zero or nonvanishing and the corresponding no-invariance group being O(5,1) when E = 0 and the O(5,1) spectrum splits into $\Sigma \oplus O(4,1)$ when $E \neq 0$ as pointed out by Salam et al. The method employed here differs from that of Cutkosky and of Salam et al. (auth)

40250 CLEBSCH–GORDAN SERIES FOR SYMMETRIZED TENSOR PRODUCTS. Andersen, C. M. (Purdue Univ., Lafayette, Ind.). J. Math. Phys. (N. Y.), 8: 988-97(May 1967).

An explicit method for obtaining the Clebsch–Gordan series for the symmetrized n-fold direct products of a finite-dimensional representation of a semisimple Lie group is discussed and il-

lustrated. The method is based on the use of weight diagrams. (auth)

40251 WEYL COEFFICIENTS IN SU(3). Lezuo, Klaus J. (Univ. of North Carolina, Chapel Hill). J. Math. Phys. (N. Y.), 8: 1163-70(May 1967).

The Weyl coefficients are by definition the matrix elements of the Weyl operators in SU(3). They are found to be generalized hypergeometric series of the type ${}_4F_3$, and can be written down in a simple way from the Gel'fand patterns involved. (auth)

40252 REDUCTION OF RELATIVISTIC WAVEFUNCTIONS TO THE IRREDUCIBLE REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP. I. NONZERO MASS COMPONENTS. Moses, H. E. (Massachusetts Inst. of Technology, Lexington). J. Math. Phys. (N. Y.), 8: 1134-54(May 1967).

When the space–time coordinates of a relativistic system undergo the transformations of the proper, orthochronous, inhomogeneous Lorentz group, the wavefunction of the system undergoes transformations which may be considered to constitute a representation of the group. A simple algorithm is given for reducing this representation to the irreducible unitary ray representations if we assume that only nonzero mass representations occur. The extension to cases in which zero mass representations occur will be given in a later paper. The form in which the reduction is given is an expansion of the wavefunction as given in configuration space in terms of a basis such that the coefficients transform in accordance with the Foldy–Shirokov realization of the irreducible representations. Any wave equation which the wavefunction satisfies and any auxiliary conditions, such as the Lorentz condition or reality conditions, eliminate or relate in a simple way some of the representations which can appear. As examples, the scalar wavefunction, the four-vector with and without the Lorentz condition, the Dirac wavefunction, the wavefunction which transforms like the electromagnetic field, and a wavefunction which transforms as a generalization of the Dirac wavefunction. In these examples it is also shown that if one replaces the amplitudes associated with the irreducible representations by annihilation and creation operators in a suitable manner, one obtains the usual canonical formalism for second quantization in configuration space. The reduction technique given herein is a simple application of the results of an earlier paper by the author and J. S. Lomont in which is shown how to reduce any unitary ray representation of the inhomogeneous Lorentz group. (auth)

40253 DOUBLE STRUCTURE OF A COMBINED INTERNAL AND SPACE–TIME SYMMETRY GROUP AND MASS SPLITTING. Fleischman, Owen; Nagel, John G. (Syracuse Univ., N. Y.). J. Math. Phys. (N. Y.), 8: 1128-34(May 1967). (NYO–3399-79; SU–1206-79).

Assuming that the group E, obtained by combining the Poincaré group P with a general internal symmetry group S, has a direct-product-like structure as occurs in the McGlinn theorem, the conditions for the existence of an isomorphism of E with a nontrivial semidirect-product-like structure are examined. It is found that a nontrivial double structure can exist if and only if S contains an internal Lorentz group L, P or their covering groups $\overline{L}$, $\overline{P}$. Mass splitting then occurs if the Poincaré group of the semidirect-product-like structure is identified as the physical space-time group. (auth)

40254 APPLICATIONS OF CURRENT ALGEBRAS. Radescu, E. E. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 19: 665-700(1967). (In Rumanian).

Symmetry groups, such as SU_3 and SU_6, have been used with great success for the classification and study of the interaction of elementary particles. These studies revealed that some of the symmetries were violated while others were conserved. It was attempted to develop a method for the treatment of such violated symmetries on the basis of generalized arguments, rather than using specific models. The first and chief effort in this direction was made by Gell–Mann who emphasized that even though the symmetry of a field theory may be violated, the charge and current commuters continue to generate a Lie group algebra at equal times; even though it is not a symmetry group of the Lagrangian, such a group may yield valuable information on the interaction of elementary particles. Commutation relations at equal times yield nonhomogeneous expressions in currents which supplement the dispersion relations in the derivation of amplitude constants of the processes. These current algebras and their applications were reviewed. The Adler–Weisberger law concerning the calculation of axial constants in β decay, the leptonic disintegration of K and π mesons were examined, reviewing also weak form factors and coupling constants in weak interactions. (Review article, 28 references). (TTT)

40255 ANALYTICITY, LOCALITY, AND SYMMETRY WITH INFINITE MULTIPLETS. Tao Wong Tyc; Nguyen Van Hieu (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 6: 186-93(July 1967).

The analytical properties of scattering amplitudes and vertex functions are studied within the framework of the symmetry with infinite multiplets. For simplicity the group SL(2, C) is considered as an internal symmetry group. The connection between quantum field theory and the symmetry with infinite multiplets is discussed. The requirement of symmetry is shown to be inconsistent with the general locality of interacting fields. (auth)

40256 CALCULATION OF INVARIANT FUNCTIONS COMPOSED OF THREE SPHERICAL HARMONICS. Marinov, M. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 6: 205-5(July 1967). (In Russian).

The generating function is found for the invariants formed by three spherical harmonics and a Clebsch–Gordan coefficient. Some recurrent formulas are obtained using this function. A simple calculation method is proposed for such invariants. (auth)

Applications (Electromagnetic and Weak)

40257 (LPTHE-TH-208) PHENOMENOLOGICAL ANALYSIS OF $K \to 3\pi$ DECAY. Gourdin, M. (Paris Univ., Orsay (France)., Laboratoire de Physique Theorique et Hautes Energies). July 1967. 62p. Dep.

A phenomenological analysis is presented of the $K \to 3\pi$ decay assuming a discrete symmetry like TCP or time reversal and possible PC violations. Particular attention is paid to the $|\Delta\vec{I}| = 1/2$ rule, and a four parameter representation of the spectra corresponding to a second order approximation of the amplitudes is defined with respect to a convenient phase-space parameter. (auth)

40258 RELATIVISTICALLY INVARIANT SOLUTIONS OF CURRENT ALGEBRAS AT INFINITE MOMENTUM. Bebie, H.; Leutwyler, H. (Univ., Bern). Phys. Rev. Lett., 19: 618-21 (Sept. 4, 1967).

It is shown that if an infinite sequence of Regge-like recurrences is taken into account, nontrivial solutions to current algebra exist which are compatible with Lorentz invariance. (L.B.S.)

40259 REMARKS ON NONLEPTONIC DECAYS IN SU_3 SYMMETRY. Pakvasa, S. (Syracuse Univ., N. Y.); Tuan, S. F. Nuovo Cim. (10), 50A: 749-57(Aug. 21, 1967). (NYO–3399-86).

Nonleptonic decays in SU_3 symmetry are examined from the point of view of the effective Hamiltonian approach, of current-current interaction with nonidentical octets, and of current commutation relations and pole model (for nonleptonic hyperon decays). The synthesis between these different approaches is spelled out. In addition, the usual derivation of forbiddenness of $K \to 2\pi$ decay in the limit of exact SU_3 symmetry is extended to include derivative couplings. (auth)

Applications (Strong)

40260 (ITF–67-5) BARYON MAGNETIC MOMENTS AND ALGEBRA OF CURRENTS. Cini, M.; De Maria, M.; Taglienti, B. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1967. 9p. Dep.

The problem of magnetic moments is reinvestigated for the purpose of determining whether the system of all the independent algebraic equations between matrix elements of currents, obtained by taking into account in the commutators the contribution of an SU(3) singlet state in addition to the octet and decuplet states, has a nonvanishing consistent solution. The interest is primarily in the symmetry properties of the solution which follow from the constraints imposed by the existence conditions. It was found that the minimal truncated set of intermediate states leading to a nonvanishing result for the magnetic moments contains, besides octet and decuplet, also an SU(3) singlet. The symmetry derived from the algebra U(3) for the weak constants and the magnetic moments with such an approximate saturation, namely, SU(3) with D/F = 3, seems therefore a better approximation than the SU(6) symmetry obtained with octet and decuplet saturation of the U(3) algebra of axial charges. (J.F.P.)

40261 (NP–16936) POLARIZATION OF RESONANCES IN A SIMPLE PERIPHERAL SU(6)W-MODEL. Doncel, Manuel G. (Ecole Polytechnique, Paris (France). Centre de Physique Theorique. Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France)). [1967]. 9p. Dep.

A simple generalization of the peripheral $SU(6)_W$-invariant model, which can be also applied to interactions of the type $P + N \to V + N$ and $P + N \to V + D$, is sketched. The polarization of the resonances in these interactions is predicted without any arbitrary parameters. Some of these predictions are compared with experimental data, and an acceptable agreement is found. Experi-

mental results on the spin and isospin character of the exchanged particle are explained. Some failures of exact $SU(6)_W$ symmetry are understood and disappear in the model. (J.F.P.)

40262 CUBIC MASS FORMULA FOR BARYONS. Soln, J. (Univ. of California, Los Angeles). Nuovo Cim. (10), 50A: 758-67(Aug. 21, 1967).

A cubic mass formula for baryons is derived in broken SU_3 symmetry. The comparison of this with the cubic mass formula derived from experiments shows quite reasonable agreement. (auth)

40263 DYNAMICAL DERIVATION OF MESON MASS FORMULAS. Pakvasa, S.; Papastamatiou, N. J. (Syracuse Univ., N. Y.). Nuovo Cim. (10), 50A: 1022-4(Aug. 21, 1967). (NYO-3399-117; SU-1206-117).

Consequences are considered for the following assumptions: SU(3) predictions for scattering amplitudes are valid asymptotically at high energies, SU(3) predictions for form factors are generally valid, the asymptotic behavior of invariant amplitudes is the one predicted by Regge theory, and the background integral contribution in the asymptotic region is either negligible or satisfies SU(3) symmetric relations. No assumptions about the mass spectrum within a given SU(3) representation is made; in particular the validity of the Gell-Mann-Okubo mass formula is not assumed. This model is applied to the elastic scattering of pseudoscalar mesons off vector mesons. (J.F.P.)

40264 THE 405 MULTIPLET MESON DECAYS. Itoh, Chiaki (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto), 37: 1239-44(June 1967).

The 1-8-27 mixing angles are calculated using observed masses and predicted ones from the 405 mass formula. 8-27 mixings are shown to be very large. $J^P = 2^+$ singlet and octet decay partial widths are estimated in the SU(3) reducible 36-multiplet model. 36-plet estimations seem to agree well with experiment rather than nonet estimates. However, very large 8-27 mixings are not desirable, and give rather small partial widths for some decay modes. From a regularity between the squared masses of the mesons, possible $J^P = 1^+$ octet is proposed. Decay modes of this 1^+ octet are discussed. (auth)

40265 COMPOSITE PARTICLE MODEL APPROACH TO THE NONLEPTONIC HYPERON DECAYS. Ohba, Ichiro (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 37: 1245-53(June 1967).

The inner structure of baryons is investigated through the nonleptonic decay of hyperons. It is assumed that the octet baryon is composed of three fundamental particles, say t's, in a bound state described by a nonrelativistic wave function, and that the weak interaction takes place through two types of elementary processes $t \to t$ and $t \to t + \pi$. First it is shown that the relations known as the $|\Delta I| = 1/2$ rule can be satisfied automatically within the framework of the present theory supplemented by the SU(3) symmetry. In particular, the parity violating amplitude is completely determined, which satisfies various relations such as the Sugawara-Lee relation and so on. Furthermore the broken SU(6) symmetry of the baryon structure is estimated from comparison of the parity conserving amplitude with the experiment $P(\Sigma^-) \approx 0$, $P(\Sigma^-)$ being the P-wave amplitude of the process $\Sigma^- \to n + \pi^-$. It is to be noted that the configuration determined there includes the 56-dimensional representation as its most dominant part consistent with the broken SU(6) symmetry obtained from the baryon leptonic decay discussed previously. (auth)

Quantum Field Theories

Refer also to abstracts 40142, 40255, and 40277.

40266 (JINR-E2-3430) FREE LOCAL FIELDS WITH INFINITE MULTIPLETS. Chi, Cao; Nguyen van Hieu (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 12p. Dep.

The possibility of the existence of free local fields involving infinite multiplets with the conventional relation between spin and statistics in the symmetry theory with noncompact groups is considered. It is shown that such fields exist and the field energy derived from the Lagrangian is positive definite. The amplitudes of crossing processes satisfy the Low substitution rule. (auth)

40267 (JINR-P2-3382) KVANTOVAYA ELEKTRODINAMIKA S VNESHNIM TOKOM I POTENTSIALOM. (Quantum Electrodynamics with an External Current and a Potential). Shirokov, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 27p. (In Russian). Dep.

The production and annihilation operators of particles are introduced, whose vacuum vector is a physical vacuum for the models: "electromagnetic field with an external current" and "electrons in an external potential" which are the components of the theory discussed. The apparatus constructed allows the corrections to the existing Lamb shift calculations to be calculated in a different manner. It allows also the problems to be solved with nonstationary currents and potentials of such a type as the radiophoton emission by the antenna or the electron scattering by the laser ray which is described by a nonquantized plane electromagnetic wave. (auth)

40268 (JINR-P2-3390) OB ODNOM KDASSE RELYATIVISTSKI-INVARIANTNYKH OBOBSHCHENNYKH FUNKTSII. (On a Class of Relativistic-Invariant Distributions). Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 22p. (In Russian). Dep.

Space-time properties of a class of relativistic invariant distributions of the type $K(x-x') = \sum_{n=0}^{\infty} |C_n/(2n)!| \Box^n \delta^{(4)}(x-x')$ were considered for different sequences of coefficients C_n. (auth)

40269 (JINR-P2-3392) KVANTOVAYA TEORIYA SKALYARNOGO POLYA V DVUMERNOM PROSTRANSTVE DE SITTERA (Quantum Theory of Scalar Field in the Two-Dimensional de Sitter Space). Tagirov, E. A.; Fedyun'kin, E. D.; Chernikov, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 21p. (In Russian). Dep.

The Fock representation is introduced for the quantum scalar field in the two-dimensional de Sitter space-time. The vacuum and n-particle states were determined. It is shown that the particles considered are not produced and annihilated in spite of the metric being nonstationary. A state of the particle is characterized by the discrete quantum number owing to the space compactness. (auth)

40270 FIELD-THEORY METHOD IN PARTICLE PHYSICS. Karolyhazy, Frigyes (Lorand Eotvos Univ., Budapest). Fiz. Szemle, 17: 161-8(June 1967). (In Hungarian).

According to the field theory, first developed during the period from 1927 to 1934, the individual photons lose their characteristics; in the $e^- + e^+ \to \gamma + \gamma$ reaction the quantum field theory to "photon field" and "electron field." Thus, the electrons and photons represent only the excitation quanta of these spaces. Although the electron-positron pair and the photon pair do not exist, except during the first and second half, respectively, of the process, both fields exist at the start and at the end, although their states change during the process. The theory correlates quantum electrodynamic phenomena, such as the photoelectric effect, Moller scattering, Compton effect, bremsstrahlung, pair formation, etc., yielding results in agreement with experimental findings. A new period started with the intensive study of strong interactions, assuming originally that the nucleon-pion interaction is similar to the electron-photon process. The more recent, 1955-60, axiomatic direction rejects the concrete field equations because they could exclude the existence of one-particle states, but requiring axiomatically that for each type of particles there must be a corresponding phenomenological field operator. (TTT)

40271 APPROXIMATE SOLUTION TO THE BETHE-SALPETER EQUATION. Cohen, H.; Pagnamenta, A.; Taylor, J. G. (Rutgers-The State Univ., New Brunswick, N. J.). Nuovo Cim. (10), 50A: 796-803(Aug. 21, 1967).

An algebraic method to obtain approximate solutions of the Bethe-Salpeter equation is presented. The approximate solutions have the correct analytic structure and satisfy elastic unitarity. They are able to produce bound states, give their qualitative position and, for attractive interactions, compare numerically quite favorably with available exact values in the elastic region. (auth)

40272 BOOTSTRAP CONDITIONS IN A MODEL FIELD THEORY. Muta, Taizo (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 37: 1291-1303(June 1967).

The bootstrap condition $Z_1 = Z_3 = 0$ in field theory is discussed in the perturbative Zachariasen model with cutoff. Special care is taken of the fact that an associated pole of the propagator appears in addition to the original one as $Z_3 \to 0$, and the "double renormalization," with respect to these two poles, is carried out which enables one to elucidate the physical significance of the bootstrap condition. It is shown that in the two-pole case the condition is essentially different from the equivalence condition between the Yukawa and Fermi theories and leads either to the decoupling limit of the associated pole or to the coalescing limit of two poles. The Reggeization condition in the sense of Kaus and Zachariasen and Ida is discussed in detail. (auth)

40273 SHORT-RANGE GAUGE FIELD. Treat, R. P. (Univ. of California, Riverside). Nuovo Cim. (10), 50A: 871-83(Aug. 21, 1967).

Non-Abelian gauge fields were investigated on the classical level. The fields are subject to the action principle employed by Yang and Mills for free gauge fields. A field which satisfies this action principle everywhere except on a world line was found; it has components which are short range and the range properties were expressed gauge invariantly. The field is singular on a world line and is thus associated with a point particle of some kind. The internal holonomy group belonging to this field is nonsemi-simple, which has the consequence that some somponents do not contribute to the energy density. The field is not expected to have a direct physical interpretation. Gauge fields with the holonomy group O_3 were also considered. An ansatz for the gauge fields has been found for which the free Yang-Mills equations acquire a relatively simple form. Due to the nonlinear nature of the equations, solutions were not obtained. However, it is shown that if the field equations are satisfied everywhere and if a long-range component of the field exists then there will also be a short-range component. (auth)

40274 WIDE-ANGLE ELECTRON-PAIR PRODUCTION WITH POSSIBLE C,T NONINVARIANCE: A SPECULATIVE INTERPRETATION OF HYPOTHETICAL DEVIATIONS FROM QED. Barshay, S.; Li, Y. (Rutgers-The State Univ., New Brunswick, N. J.). Nuovo Cim. (10), 50A: 824-36(Aug. 21, 1967).

One possible interpretation of hypothetical deviations from quantum electrodynamics of a particular type is discussed. The basic hypothesis of the model provides an origin for the possible enhanced sensitivity of a high-energy, wide-angle electron-pair production experiment to such deviations, and also predicts that the deviation will be in the direction of an excess of wide-angle pairs. The model is subject to a feasible experimental test through a study of the pair production process with linearly polarized photons. This is due to the circumstance that the ordinary QED matrix element vanishes in the symmetric experimental arrangement, for photons polarized normal to the plane containing the beam and the electron pair. (auth)

40275 HIGHER-ORDER CONTRIBUTIONS TO THE DIVERGENT PART OF Z_3 IN A MODEL QUANTUM ELECTRODYNAMICS. Rosner, Jonathan L. (Univ. of Washington, Seattle). Contract AT(45-1)-1388. Ann. Phys. (N.Y.), 44: 11-34(Aug. 1967). (RLO-1388B-508).

The divergent part of Z_3^{-1} is found to be $(Z_3^{-1})_{div} = \alpha_0/2\pi\ [2/3 + \alpha_0/2\pi - 1/4\ (\alpha_0/2\pi)^2]\ \log M^2/m^2$ to sixth order in the bare charge e_0, in a model in which corrections to internal photon lines in the vacuum polarization tensor are neglected. The simplicity and sign of the sixth-order term are of interest in the program to make quantum electrodynamics a consistent finite theory. (auth)

40276 CONSERVED CURRENTS, RENORMALIZATION, AND THE WARD IDENTITY. Boyer, Timothy H. (Harvard Univ., Cambridge, Mass.). Ann. Phys. (N.Y.), 44: 1-10(Aug. 1967).

The field-theoretic connection between the conservation of local currents and the absence of renormalization is reviewed. Generalizations of two proofs of the relationship, one given by Okubo and repeated by Fubini and Furlan, and the other through traditional use of the Ward identity, are compared and found to use precisely the same information and to apply to the same situations. The Okubo form is seen to be exactly the spatial integral of the zero component of the Ward identity at the mass shell singularity. The several derivations of the Ward identity in quantum electrodynamics are compared. Contrary to suggestions in the literature, none of the proofs makes use of invariance of the Lagrangian under gauge transformations of the second kind, but all use symmetry under gauge transformations of the first kind reflected in the conserved electromagnetic current. The method of Takahashi in the derivation of the generalized Ward identity is used to allow derivation of the formulas connecting Green's functions with the associated functions obtained by inserting arbitrarily many finite-momenta external photons. Conversely, the Green's function identities imply a symmetry of the equations of motion, and the conservation and generator aspects of the associated current. (auth)

40277 BOGOLIUBOV-PARASIUK-HEPP RENORMALIZATION THEOREM AND SPACELIKE REGULARIZATION. Brandt, Richard A. (Univ. of Maryland, College Park). J. Math. Phys. (N. Y.), 8: 1112-20(May 1967).

Hepp's recent proof that the Bogoliubov–Parasiuk renormalization prescription leads to finite integrals after the employed space–time regularization of the Green's function is removed is extended to a case in which only spacelike regularization is used. (auth)

40278 LEADING LANDAU CURVES FOR A LARGER CLASS OF FEYNMAN DIAGRAMS. Pattnaik, Mamata (Saha Inst. of Nuclear Physics, Calcutta). J. Math. Phys. (N. Y.), 8: 1155-62(May 1967).

The leading parts of Landau curves for a larger class of Feynman diagrams are found to give no singularities on the physical sheet provided certain conditions are imposed upon the external and internal masses. The number of such masses involved is found to be fixed, no matter how complicated a member of this class is considered. (auth)

40279 CLASS OF NONANALYTIC PERTURBATIONS IN QUANTUM MECHANICS. Frank, William M. (Naval Ordnance Lab., Silver Spring, Md. Bar-Ilan Univ., Israel). J. Math. Phys. (N. Y.), 8: 1121-7(May 1967).

It is shown that the resolvent operator for the Hamiltonian which is the sum of the harmonic oscillator Hamiltonian H_0 and a polynomial perturbation gP(x) of degree exceeding two (g is a coupling constant) is not expressible as a convergent power series in g. The source of this nonanalyticity is the failure of the anharmonic perturbation operator to be small in norm compared to H_0. The nature of the singularity at g = 0 is conjectured. The result makes clear that the divergence of the Ward–Hurst–Thirring model has nothing to do with the "difficulties" of field theory which are related to the infinite number of degrees of freedom of a field. (auth)

40280 DOUBLE LOGARITHMIC ASYMPTOTICS IN QUANTUM ELECTRODYNAMICS. Gorshkov, V. G.; Gribov, V. N.; Lipatov, L. N.; Frolov, G. V. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 6: 129-40(July 1967). (In Russian).

The reasons for the double logarithmic asymptotics of the Feynman graphs are considered. Two-particle processes in the quantum electrodynamics are classified according to their asymptotic behavior. The processes with the double logarithmic asymptotics are indicated. The asymptotics of the amplitude and of the cross section for the forward $e^+e^- \to \mu^+\mu^-$ reaction and for the backward $e^-\mu^-$ scattering are obtained summing the essential Feynman graphs directly. The obtained asymptotics are discussed in view of the partial amplitudes in the crossed channel at the complex angular momenta. (auth)

40281 ASYMPTOTIC BEHAVIOR SPECTRAL DENSITY IN NONRENORMALIZABLE THEORY. Pevzner, M. Sh. (Dnepropetrovsk Mining Inst., USSR). Ukr. Fiz. Zh., 12: 700-1(Apr. 1967). (In Russian).

Singularity aspects of light cones are contradictory to the findings of the Kallen-Lehman principle. A similar situation arises in the case of the summation of series of the excitation theory in renormalizable theories. Deviation from the axiomatic case may be due the nonphysical nature of the original Hamiltonian and to an unsuitable approximation method. If the second reason is correct, the nonphysical characteristics may be eliminated from the propagators. This problem was considered for the case of a model of the nonrenormalizable interaction of scalar particles with massive vector fields, based on the Lagrangian of the interaction. An integral equation which satisfies the spectral density requirement of scalar particles was derived and solved. In the actual case, the nonrenormalizable theory propagator may not have the required spectral representation and therefore the theory may not be interpreted locally. (TTT)

40282 CONTINUOUS TENSOR PRODUCTS BY BANACK SPACED AND ALGEBRAS. Guichardet, A. (Univ., Poitiers, France). Commun. Math. Phys., 5: 262-87(1967). (In French).

The notion of tensor product of a family $(A_i)_{i\in I}$ of Banach algebras is generalized to the case when I is a topological space; in this case $\hat{\otimes} A_i$ is generated by some elements $\otimes x_i$, the family (x_i) being subjected to certain conditions: for instance the function $i \to ||x_i||$ must be continuous. This notion is applied to quantum field theory in the following sense: certain algebras of observables can be considered as continuous tensor products of simpler ones, namely of algebras of observables with one degree of freedom. (auth)

Scattering Theory

40283 (IC-67/52) THREE LECTURES ON TENSOR OPERATORS IN U(n): AN INTRODUCTION TO AN "OPERATOR CALCULUS OF PATTERNS." Biedenharn, L. C. (International Centre for Theoretical Physics, Trieste (Italy)). July 1967. 37p. Dep.

The problem of extending the concepts of the Wigner–Racah angular momentum calculus to an arbitrary symmetry group is considered. An attempt is made to develop a canonical resolution of the multiplicity for U(n) for the first nontrivial case U(3). The SU(2) Wigner–Racah calculus is reconsidered, and certain key features are extracted for generalization. The same theme is developed for SU(3), and the general SU(n) problem is discussed in terms of a canonical embedding and the factorization lemma for the boson calculus. Finally, the pattern calculus as it applies to elementary operators is discussed. (J.F.P.)

40284 (UCRL-17652) THE APPLICATION OF ANALYTICITY PROPERTIES TO THE NUMERICAL SOLUTION OF THE SCHROEDINGER AND BETHE-SALPETER EQUATIONS. Haymaker, Richard Webb (California Univ., Livermore. Lawrence Radiation Lab.). July 13, 1967. Contract W-7405-eng-48. 104p. Dep. CFSTI.

Thesis.

A new method of calculating phase shifts from the Bethe-Salpeter equation is presented. The differential equation is solved below threshold using a variational method and then the scattering amplitude is continued to the physical scattering region using Padé approximants. The singularity structure of the Schrödinger and Bethe-Salpeter amplitudes in their off-shell variables was studied to find the nearby singularities that could most strongly affect the continuation. A variational method of calculating Regge trajectories in potential theory is presented. The variational equations are derived in the bound state region and then continued directly to all values of angular momentum and energy. (auth)

40285 GENERATION AMPLITUDE IN SCALAR, CHARGED MODEL. Ambros, Arne A. (Univ., Vienna). Acta Phys. Austr., 25: 5-29(Apr. 1967). (In German).

The integral equation for the generation amplitude in a scalar charged model was derived beginning with the Hamilton operator and the fermion-boson scattering and the Low equation of the model. The homogeneous and inhomogeneous integral equations were solved. (J.S.R.)

40286 MULTIPARTICLE COLLISIONS. I. ANGULAR MOMENTUM EIGENSTATES. Cook, J. L. (Atomic Energy Commission Research Establishment, Lucas Heights, Australia). Aust. J. Phys., 20: 347-53(Aug. 1967). (AAEC-TM-357).

The current situation with regard to relativistic representation of multiparticle angular momentum eigenstates is reviewed, and it is concluded that no generally satisfactory formalism exists. Difficulties with the formalism are outlined, and a general method of construction of partial-wave amplitudes is put forward. (auth)

40287 MULTIPARTICLE COLLISIONS. II. APPLICATION OF UNITARITY. Cook, J. L. (Atomic Energy Commission Research Establishment, Lucas Heights, Australia). Aust. J. Phys., 20: 355-61(Aug. 1967). (AAEC-TM-358).

The application of unitarity to multiparticle production processes is studied, and relations between production and scattering amplitudes are derived. (auth)

40288 TRANSVERSITY AMPLITUDES AND HIGH-ENERGY BEHAVIOR. Cohen-Tannoudji, G.; Morel, A.; Navelet, H. (CEN, Saclay, Gif-sur-Yvette, France). Nuovo Cim. (10), 50A: 1025-8(Aug. 21, 1967).

Two applications of previous results of a detailed study of the analyticity properties of two-body helicity amplitudes are discussed. The first deals with the question of subtraction constants in dispersion relations, and the second with the formulation of Regge pole models. Both applications make use of the transversity amplitudes which are defined from the helicity amplitudes. (J.F.P.)

40289 EXACT FORMULA FOR THE PHASE SHIFTS. Tietz, T. (Univ. of Lodz, Poland). Nuovo Cim. (10), 50A: 923-6 (Aug. 21, 1967).

A method to determine the phase shifts of the Schrödinger equation is given. An exact formula convenient for practical calculations of the phase shifts is derived. (auth)

40290 EXISTENCE OF THE MANY-CHANNEL N/D REPRESENTATION. Warnock, R. L. (IAEA, Trieste, Italy). Nuovo Cim. (10), 50A: 894-922(Aug. 21, 1967). (IC-67/2).

Existence of the N/D representation is proved for an appropriate class of scattering matrices. The proof refers to a finite number of two-body channels. Alternatively, it refers to the N/D method with absorption in which n two-body channels appear explicitly, and all other channels are taken into account by absorption parameters. The existence theorem requires asymptotic conditions on the scattering matrix weaker than those needed in earlier work on the subject. The conditions are compatible with the Regge-pole model of asymptotic behavior provided the N/D method with absorption is used. An important factorization of the general D-matrix is obtained in the form $D = \mathfrak{D} R$, where $\mathfrak{D}$ is a certain matrix which is nonsingular and free of poles at all finite points of the plane, and R is a matrix of rational functions. An analogous factorization is familiar in the single-channel problem, where $\mathfrak{D}$ is an exponential function of a phase-shift integral. By means of the formula $D = \mathfrak{D} R$, generalized Levinson relations are formulated. One such relation is new; it has to do with n two-body channels, but does not involve neglect of the other channels. (auth)

40291 THRESHOLD BEHAVIOR OF PARTIAL-WAVE AMPLITUDES. Dilley, J. (Ohio Univ., Athens). Nuovo Cim. (10), 50A: 837-49(Aug. 21, 1967).

The implications of the known threshold behavior of the partial-wave amplitudes are discussed in terms of the restrictions which it places on the imaginary part. Applying these considerations to the N/D method, it is shown that an arbitrary input, originally inconsistent with the threshold properties, can be modified by the addition of simple poles to bring it into agreement with these properties. A model calculation is carried out for Yukawa potential scattering, and it is shown that the modification procedure does indeed improve the results. (auth)

40292 ANALYTIC CONTINUATION OF LAPLACE TRANSFORMS BY MEANS OF ASYMPTOTIC SERIES. Beyer, W. A.; Heller, L. (Los Alamos Scientific Lab., N. Mex.). J. Math. Phys. (N. Y.), 8: 1004-18(May 1967). (LA-DC-7744).

Conditions under which a Laplace transform $L\{F(t)\} = f(s)$ may be analytically continued, by means of an asymptotic expansion of F, outside the half plane of convergence of the Laplace transform integral are investigated. For $t > k$ define R_N by $F(t) = t^{-\beta}\{\Sigma_{i=0}^{N} a_i t^{-i} + R_N(t)\}$ for some fixed β with $\mathrm{Re}\,\beta < 1$ and suppose that F is integrable on [0,k] for some $k \geq 0$. First, it is shown that if $R_N(t) = O\{N!(\sigma/t)^{N+1}\}$ uniformly in N and $t > k$ for some $\sigma > 0$, then the singular part of f at $s = 0$ can be determined in terms of a_i. If β is an integer, then in some neighborhood of $s = 0$ it is shown that $L\{F(t)\} = s^{\beta-1}\Sigma_{i=0}^{-\beta} a_i\Gamma(1 - i - \beta)\, s^i + (\log s)\, g(s) + h(s)$, where g and h are analytic at $s = 0$ and $g(s) = \Sigma_{i=0}^{\infty} (-1)^i a_{i-\beta} s^{i-1}/(i-1)!$. If β is not an integer, in some neighborhood of $s = 0$ it is shown that $L\{F(t)\} = s^{\beta-1}g(s) + h(s)$, where $g(s) = \Sigma_{i=0}^{\infty} a_i\Gamma(1-i-\beta)s^i$, with g and h analytic at $s = 0$. Second, if the estimate on $R_N(t)$ holds uniformly in N and in the complex t plane in the region $(|t| > k) \cap (|\arg t| < (\frac{1}{2}\pi) + \lambda)$ for some $\lambda > 0$, then the analytic continuation of f can be determined in terms of the a_i. For any $k' > k$ and for $|\arg s| < \pi$ we have $L\{F(t)\} = \int_k^{k'} e^{-st} F(t)\, dt + \int_{k'}^{\infty} a(t)\, \Gamma(2-\beta, k'(s+t))\, (s+t)^{\beta-2}\, dt$, where Γ is the incomplete gamma function and a(t) is the analytic continuation of $\Sigma_{i=0}^{\infty} a_i t^i/i!$. If $k = 0$ in the hypotheses, then with a slight further restriction on F(t) one has $L\{F(t)\} = \Gamma(2-\beta)\int_0^{\infty} a(t)\, (s+t)^{\beta-2}\, dt$. A generalization and application to a problem in nonrelativistic dispersion theory which includes a Coulomb potential are discussed. (auth)

40293 COMPLETE EXCITATION SPECTRA. Anderson, J. T. (Univ. of California, Riverside). J. Math. Phys. (N. Y.), 8: 998-1003(May 1967).

A type of nonhomogeneous integral equation frequently encountered in interaction problems is solved by means of the Heaviside expansion theorem. The energy spectrum is obtained in the usual way from the solutions of the dispersion equation for the excitations, $D(k,s) = 0$. The momentum spectrum is obtained as the solutions of $\partial D/\partial k = 0$, which is shown to be also a form of the Cauchy–Riemann equations. It is proved that the existence of a solution of $\partial D/\partial k = 0$ is a necessary condition for the existence of an analytic region on the momentum plane. It is also proved that the existence of a solution of $dD/dk = 0$ and $\partial D/\partial s = 0$ is a necessary and sufficient condition for the existence of analytic regions in both variables, provided the group velocity is finite and continuous. As an example, two linearized self-consistent equations with arbitrary coupling are solved. (auth)

40294 WIGNER METHOD IN QUANTUM STATISTICAL MECHANICS. Imre, Kaya (Cekmece Nuclear Research and Training Center, Istanbul); Ozizmir, Ercument; Rosenbaum, Marcos; Zweifel, P. F. J. Math. Phys. (N. Y.), 8: 1097-1108(May 1967).

The Wigner method of transforming quantum-mechanical operators into their phase-space analogs is reviewed with applications to scattering theory, as well as to descriptions of the equilibrium and dynamical states of many-particle systems. Inclusion of exchange effects is discussed. (auth)

40295 ON THE EXPANSION OF THE SCATTERING AMPLITUDE IN FUNCTIONS INTERPOLATING LEGENDRE POLYNOMIALS. Gersten, A. (Weizmann Inst. of Science, Rehovoth, Israel). Ann. Phys. (N.Y.), 44: 112-25(Aug. 1967).

An investigation was made of scattering-amplitude expansions in functions characterized by the poles of the analytic continuation of the S-matrix elements in the complex angular plane. An analytical expression is given for the one pole contribution to the scattering amplitude. (auth)

40296 GENERAL STRUCTURE OF A UNITARY S-MATRIX FOR FINITE MANY-CHANNEL SCATTERING. Dahmen, H. D.; Reiner, A. S. (Weizmann Inst. of Science, Rehovoth, Israel). Ann. Phys. (N.Y.), 44: 74-83(Aug. 1967).

The most general solution of the unitarity relations for the S-matrix for elastic, inelastic and rearrangement processes below break-up is given in terms of one many-valued real-analytic function D of the total energy. (auth)

40297 PARTICLE SCATTERING ON A SYSTEM OF FIXED CENTERS. Amirkhanov, I.; Demin, V. F.; Zakhar'ev, B. N.;

Kuz'min, I. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 6: 194-204(July 1967). (In Russian).

Multiple scattering is considered of a particle on a system of static force centers whose regions of interaction with the particle do not overlap (or do not overlap too much). The problem is shown to reduce to the solving of a simple set of algebraic equations. The number of the equations depends on the number of the centers and on the number of retained partial waves in the scattering amplitude for the single centers. The generalization to the case of particles with spin and photons is carried out. (auth))

40298 BRANCHING POINTS IN THE j-PLANE AND THE HIGH ENERGY ASYMPTOTICS OF SCATTERING AMPLITUDE. Gurvits, S. A. (Moscow Physical-Technical Inst.). Yadern. Fiz., 6: 141-5(July 1967). (In Russian).

The contribution of branching points in the j-plane to the charge exchange amplitudes at high energies is found under some assumptions. The data are given to compare with future experiments at high energies and small momentum transfers. (auth)

Particle Accelerators

Refer also to abstracts 39088, 39186, 39802, 40142, 40366, 40421, 40429, 40473, and 40474.

40299 (CALT-68-139) BEAM ENERGY METER AND BEAM ENERGY CONTROL. Internal Report No. 34. Maloy, J. O. (California Inst. of Tech., Pasadena. Synchrotron Lab.). Aug. 4, 1967. Contract AT(11-1)-68. 62p. Dep. CFSTI.

The Beam Energy Meter indirectly measures the energy of the internal electron beam in the Synchrotron. The quantity actually measured is the magnetic flux in a pickup coil of known area placed at a known radius between the pole tips of the main guide magnet. The Beam Energy Meter integrates the output voltage of the pickup coil and provides a visual digital indication of the integral (the flux). The Beam Energy Control is used to control the voltage applied to the Synchrotron magnet so that the energy may be kept constant within about ±1 MeV (±0.07%). The main generator voltage regulator system controls the energy to about ±1% (±15 MeV at full energy). The Beam Energy Control adds a small correction into the regulator loop to achieve the desired ±1 MeV. The correction is computed by comparing the digital output of the Beam Energy Meter with the output of a 4 decade thumbwheel switch set to the desired energy. The analog control signal is obtained by rectifying and averaging a pulse-width-modulated 400 Hz square wave superimposed upon a 25.6 kHz carrier. (auth)

40300 (COO-1195-96) REPORT ON THE RECENT BEAM SURVEY OF THE INTERMEDIATE ENERGY MESON BEAM IN THE PROTON AREA AT THE ZGS. Technical Report 160. Hassenzahl, W. V.; Mencuccini, C.; Beier, E.; Edwards, R.; Herzo, D.; Koester, L. J.; Wattenberg, A. (Illinois Univ., Urbana. Dept. of Physics). June 1967. Contract AT(11-1)-1195. 50p. Dep. CFSTI.

The primary purpose of the beam survey performed in February, 1967, was to determine the K^+ and π^+ fluxes to be expected in future experiments in this beam. The fluxes obtained with a ±1% momentum bite are given. The effect of target thickness on total production is shown. The extrapolation to 0 thickness is used in calculating cross sections. Observed production cross sections are quite similar to those of Novey et al. The π^+, K^+, p and $\bar{p}$ production cross sections from Be, Cu, Ta is used to find the relative production as a function of A. Deviations from the $A^{\frac{2}{3}}$ law are as large as a factor of 1.6. (auth)

40301 (JINR-P9-3402) RASSEYANNOE IZLUCHENIE V POMESHCHENIYAKH USKORITELEI. (Stray Radiation at Accelerator Halls). Kimel', L. R.; Komochkov, M. M.; Sidorin, V. P.; Sychev, B. S.; Cherevatenko, E. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1967. 24p. (In Russian). Dep.

The problems of stray radiation at accelerator halls were considered. Approximate formulas for calculation of stray radiation fluxes of different energy groups are obtained. The method suggested is applied for calculations of stray radiation fields at the JINR synchrocyclotron hall. (auth)

40302 (JINR-P9-3415-2) SINKHROTRONNOE IZLUCHENIE RELYATIVISTSKIKH ZARYADOV V METALLICHESKOI TRUBE. (Synchrotron Radiation of Relativistic Charges in a Metal Tube). Bonch-Osmolovskii, A. G.; Reshetnikova, K. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1967. 15p. (In Russian). Dep.

The problem is solved of the radiation of charges having a spiral path in a magnetic field inside a hollow round metal tube. An expression is obtained, in a general form, for the radiation intensity of an azimuthal-inhomogeneous thin charged ring. It is shown, in particular, that the charges do not radiate at all when their radius of rotation is rather similar to that of the tube. (auth)

40303 (JINR-P9-3434-1) VLIYANIE LOKAL'NYKH NEODNORODNOSTEI MAGNITNOGO POLYA NA DVIZHENIE CHASTITS V USKORITELYAKH S PROSTRANSTVENNOI VARIATSIEI. (Effect of Local Inhomogeneities of the Magnetic Field on Particle Motion in Space Variation Accelerators). Dmitrievskii, V. P.; Prilipko, T. M.; Rybalko, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 33p. (In Russian). Dep.

The effect of the gradient local inhomogeneities of the magnetic field on particle motion in space variation accelerators is investigated on the basis of the matrix method. The possibilities of using such perturbations for beam extraction by the resonance method are considered. (auth)

40304 (NP-16809) ENTWICKLUNG EINES 100-MeV FFAG-ELEKTRONENSYNCHROTRONS. (Development of a 100-MeV FFAG Electron Synchrotron). Petzold, Wolfgang (Freie Universitaet, Berlin (West Germany). I. Physikalisches Institut). Jan. 1965. 58p. (In German). DTIE.

The equation for the calculation of the scaler magnetic potentials for the guide fields of an FFAG electron synchrotron in the region of the pole surface and in the pole shoe range were derived. Numerical calculations were carried out for the pole surface region and the pole shoe region. The results are shown graphically. In an appendix the calculations of the coefficients A_n of the inverse power series are given. (J.S.R.)

40305 (NP-17011) IONNO-OPTICHESKOE SOGLASOVANIE METODOM SLUCHAINOGO POISKA. (Ion-Optic Matching by Random Search Method). Vecheslavov, V. V.; Kononov, V. I. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). 1967. 10p. (In Russian). Dep.

The matching system is used for transformation of the transverse phase volume of the injector into one of the next focusing system. The case of the matching system of four or more quadrupoles is considered. This arrangement is described by a vector χ, components of which are gradients and lengths of quadrupoles. In every case χ matching system is able to secure a definite transformation of the phase volume. Some scalar function $Q(\chi)$ shows how this transformation is close to ideal. A search of the state χ^* which secures $Q(\chi^*) \simeq 0$ and solves a matching problem is realized by random search method. By using this method in concrete cases one may have several solutions $\{\chi\}$ which differ, for example, in maximum size of the beam. (auth)

40306 (SLAC-76) THROBBING BEAM TRANSVERSE RESISTIVE INSTABILITIES IN CIRCULAR ACCELERATORS AND STORAGE RINGS. Lee, M. J.; Mills, F. E.; Morton, P. L. (Stanford Linear Accelerator Center, Calif.). Aug. 1967. Contract AT(04-3)-515. 68p. Dep. CFSTI.

A study was conducted of the cross-sectional oscillations of a nearly circular beam centered in a circular pipe, and a self-consistent solution was obtained for both monopole and multipole oscillations. Dispersion relations for the oscillation frequencies were found, and conditions for stability were deduced. For multipole instabilities the growth rates and thresholds are close to those obtained for the dipole instability, differing only by a geometrical factor; whereas, for the monopole instability, the growth rates are so small that the oscillations in present accelerators and storage rings will be suppressed by the physical processes such as interaction with the residual gas, radiation damping, etc. In all cases, the growth rate is proportional to the number of particles in the beam and inversely proportional to the square root of the wall conductivity. It is shown that in the absence of Landau damping a longitudinally continuous beam is always unstable against the development of transverse waves having a phase velocity close to $(n - m\nu_\beta)\,\Omega R$, where ν_β is the number of betatron oscillations per revolution, Ω is the revolution frequency, R is the radius of the machine, n is an integer greater than $m\nu_\beta$ with 2m the multipole number (m = 1 for dipole and m = 2 for quadrupole, etc.). A condition for stable multipole oscillations for a single bunched beam is found to be $n < \nu_\beta < [n + (1/2m)]$. It is known that unstable oscillations can be Landau damped by having a sufficiently large spread in the betatron oscillation frequency $\nu_\beta\,\Omega$. A criterion for the spread required to damp unstable quadrupole oscillations of a bunched beam is shown to be, in the limit of low energy, dependent upon the particle density, energy and the betatron oscillation frequency, but not upon the conductivity. For the case of equal horizontal and vertical betatron frequencies monopole and multipole oscillations can exist independently. However, for the case of a large difference between the two frequencies, it is found that coupling exists between monopole and quadrupole oscillations, and the motion of the beam is characterized by two normal modes such that the monopole and

quadrupole oscillations are in phase in one mode and 180° out of phase in the other. (auth)

40307 (UCRL-17354) COST OPTIMIZATION OF STORAGE RING MAGNET SYSTEMS. Green, Michael A. (California Univ., Berkeley. Lawrence Radiation Lab.). June 14, 1967. Contract W-7405-eng-48. 14p. (CONF-670705-12). Dep. CFSTI.

From 2nd International Conference on Magnet Technology, Oxford, England.

A magnet cost optimization analysis is made of storage ring magnet systems. Three systems studied are the CERN intersecting storage ring, the Omnitron storage ring, and a hypothetical dc storage ring of the same size, shape, and field as the June 1965 version of the Injector Synchrotron for the 200-BeV Design Study. (W.H.K.)

40308 (UCRL-17661) BUS BAR QUICK DISCONNECT PROPOSED FOR THE 200-GeV ACCELERATOR. Satti, John A. (California Univ., Berkeley. Lawrence Radiation Lab.). July 6, 1967. Contract W-7405-eng-48. 8p. (CONF-671102-15). Dep. CFSTI.

For Presentation at 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

Residual radiation has become an important parameter in the design of the 200-GeV accelerator since it is expected to have radiation levels of 200 R/h along 5% of the circumference of the main ring 7 hr after beam cutoff. In order that maintenance of equipment associated with the accelerator can be undertaken a remote handling situation is required. A proposed bus bar quick disconnect is described which will enable remote handling of associated equipment by master-slave manipulators. (B.G.D.)

40309 APPLICATION OF THE TURBOMOLECULAR PUMP TO PARTICLE ACCELERATORS USING NEW THEORETICAL DATA. Becker, W. (Arthur Pfeiffer Hochvakuumtechnik GmbH, Wetzlar, Ger.). Vide, 22: 152-6(May-June 1967). (In French).

Considering the design of the turbomolecular pump an equation will be derived, in order to determine the pressure ratio of the pump theoretically from the geometric dimensions. This equation shows that the pressure ratio increases considerably with rising molecular weight of the gases. E.g. the pressure ratio for mass 120 is higher than 10^{18}. Furthermore, curves will be shown from which the suction speed of the turbomolecular pump in combination with a backing pump of definite size can be calculated. Examples for the application of turbomolecular pumps with particle-accelerators are presented. (auth)

40310 A SLOW EXTRACTION OF PROTONS FROM A 70 GeV SYNCHROTRON. Globenko, Yu. G.; Koshkarev, D. G. (Inst. of Theoretical and Experimental Physics, Moscow). Prib. Tekh. Eksp., No. 2, 14-17(Mar.-Apr. 1967). (In Russian).

A system for slow extraction from a 60- to 70-GeV proton synchrotron was designed on the basis of quadratic nonlinearity of resonance harmonics. It is shown that the extraction can be achieved by means of compensating hexapole windings and separator magnets. (tr-auth)

40311 MEASUREMENT OF THE TEMPERATURE OF THE DEFLECTOR BLADE. Dobias, Jindrich; Fukatko, Tomas; Pergl, Petr (Inst. of Nuclear Research, Czechoslovakian Academy of Sciences, Rez). Jad. Energ., 13: 109-10(Mar. 1967). (In Czech).

A simple device is described which enables measurement of the inlet part of the cyclotron deflecting channel, which was sometimes overloaded thermally and destroyed during the extraction of a beam of accelerated particles at a higher intensity. Operating with the described device the temperature of the inlet deflector part of the U-120 cyclotron was permanently decreased below 1000°C when a beam of 135 MeV, 80 μA deuterons was extracted into the target chamber. (auth)

40312 INCREASING THE INTENSITY OF BREMSSTRAHLUNG EMISSION OF A BETATRON. Sukhanova, K. A.; Puzanov, A. A. Tr. Ural. Politekh. Inst., No. 143, 29-35(1965). (In Russian).

The operation of the orbital magnetic contractor has a major effect on the bremsstrahlung intensity from a betatron. The use of a two-channel circuit for controlling the contractor and injector to increase the strength of the bremsstrahlung emission is described. (B.G.D.)

40313 MEASUREMENT OF THE ABSOLUTE VALUES OF THE MAGNETIC FIELD IN THE UPI CYCLOTRON. Panov, V. P.; Tel'minov, M. M. Tr. Ural. Politekh. Inst., No. 143, 71-3(1965). (In Russian).

The absolute value of the magnetic field in the center of the UPI cyclotron magnet was found to be 14,102 Oe ± 0.02%. The curve for the decrease in magnetic field along the radius and for the energy of the deuteron as a function of radius is presented. (B.G.D.)

40314 ELECTRON ACCELERATORS AND GENERATORS OF ULTRAHARD X RAYS. Wachsmann, Felix; Berger, H. (Institut fuer Strahlenschutz der Gesellschaft fuer Strahlenforschung, Neuherberg, Ger.). pp 85-120 of Handbuch der Medizinischen Radiologie, Vol. 1, Part 2. Berlin, Springer-Verlag, 1965. (In German).

The basis in radiotherapy for development of high energy, penetrating radiation sources is discussed briefly, and the relation between the relative depth dose and tube voltage or radiation energy is outlined. Various types of accelerators are discussed. These include the direct accelerator of which the x-ray tube is an example and the high-voltage generators, including cascade generators, resonance transformers, isolation core transformers, and electrostatic generators. Acceleration tubes are described. General principles and characteristics of linear accelerators are discussed. Examples described are the early developed step accelerator and the traveling wave accelerators, such as the linear accelerators. The orbital accelerators, such as the betatron, which is an induction accelerator, the synchronous accelerator (synchrotron), and the electron cyclotron (microtron) are described; their principles of operation are succinctly summarized; and examples of their uses are given. Accelerators that use a new principle of focussing with alternating gradients are described in detail. 173 references. (BBB)

40315 SOME OF THE CHARACTERISTICS OF THE BETATRON BREMSSTRAHLUNG. Sukhanova, K. A.; Puzanov, A. A.; Sazykin, V. V.; Dvinyaninov, B. L.; Bagaev, V. N. Tr. Ural. Politekh. Inst., No. 143, 26-8(1965). (In Russian).

The characteristics of bremsstrahlung produced by a betatron are discussed. The spectrum and isodose curves are presented. The limiting energy of the betatron was found to be 13 to 14 MeV. (B.G.D.)

40316 "NINA" THROUGH A LOOKING GLASS. Instrum. Rev., 14: 335-6(Aug. 1967).

A brief description is given of the new 4-GeV electron synchrotron, termed NINA (National Institute Northern Accelerator), at the Daresbury Nuclear Physics Laboratory of the U. K. Science Research Council. Features described include the rf power supply, the magnet power supply, the injection system, the vacuum system, the central control room, and the associated computer laboratory. Experimental programs are outlined. (UK)

40317 ERRORS IN MEASUREMENT OF A MAGNETIC FIELD VERSUS ACCURACY OF COMPUTED PARTICLE TRAJECTORIES. A SYSTEM ANALYSIS. Groth, T.; Olsen, B.; Pettersson, G. (Univ. of Uppsala). Nucl. Instrum. Methods, 55: 93-104(Sept. 1967).

A system analysis which makes it possible to design the most economical method of measurement in order to get a desired accuracy is presented. The procedure is based on computer simulation. It is applied to the problem of computing particle trajectories in a measured magnetic field and is made to establish the relation between the accuracy of the calculated trajectories and some measurement-dependent factors such as the precision in positioning, sensitivity of the Hall-probe etc. (auth)

40318 ION EXTRACTION IN THE PRESENCE OF SECONDARY ELECTRONS. Marsicanin, B. S. (Boris Kidric Inst. of Nuclear Science, Belgrade). Nucl. Instrum. Methods, 55: 170-2(Sept. 1967).

Using an idealized model for the plasma sheath at ion extraction the effect of the presence of secondary electrons on the sheath thickness was calculated. The change in carrier density is taken into consideration. The influence on the extracted beam emittance is discussed and the total effect compared with available experimental evidence. (auth)

40319 INJECTOR OF THE OXFORD ELECTROSTATIC GENERATOR PROJECT. Allen, W. D.; Dawton, R. H. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Instrum. Methods, 55: 61-79(Sept. 1967).

The vertical injector provided for the Oxford electrostatic generator project is described. Beams of negative hydrogen ions were accelerated to 10.2 MeV, of negative oxygen ions to 9.5 MeV, and of alpha particles to 15.6 MeV, corresponding to a terminal voltage of 9.7 MV. In operation coupled with the tandem, protons were accelerated to energies of 20 MeV, with currents of 200 nA. (auth)

40320 ELECTRON RING PHASOTRON. Kazanskii, L. N.; Kanunnikov, V. N.; Kolomenskii, A. A.; Ovchinnikov, E. P.; Papadichev, V. A.; Semionov, S. S.; Fateev, A. P.; Yablokov, B. N. (Lebedev Inst. of Physics, Moscow). Nucl. Instrum. Methods, 55: 15-28(Sept. 1967).

The physical basis for the choice of parameters of the ring phasotron of the Lebedev Physical Institute and special features

of its construction are considered. The process of putting the accelerator into operation is described. The results obtained when working with a beam are discussed. (auth)

40321 NOVEL INFLECTORS FOR CYCLIC ACCELERATORS. Mueller, R. W. (AEG-Forschungsinstitut, Frankfurt am Main). Nucl. Instrum. Methods, 54: 29-41(Sept. 1967).

After discussing briefly the existing types of inflectors for particles moving in a homogeneous magnetic field, two new types of inflectors are discussed. The equations of motion allow rigid integration; linear expansion leads to beam transfer optics. The combined effects of the inflector beam optics and the optics of the beam transfer system are described. As to beam optics, the hyperboloid inflector seems to be ideally suited for isochronous cyclotrons. The second development, the parabolic inflector, though with regard to beam optics less interesting than the hyperboloid inflector, yet is advantageous in other respects. (auth)

40322 IONIZING GAS IN ACCELERATION GAP OF THE GAS FILLED NEUTRON TUBE. Sokolov, Yu. I. Prib. Tekh. Eksp., No. 2, 199-201(Mar.-Apr. 1967). (In Russian).

The operation of small-dimension neutron generators, with gas-filled tubes, as pulsed fast neutron sources met with some interference caused by nonstationary time distribution of neutrons. An attempt was made to determine the causes producing such a nonstationary time distribution of the neutrons. (R.V.J.)

40323 TRANSFORMER FOR PHASE SHIFT MEASURING IN THE STORAGE RING. Pirushkin, E. A.; Starodubtseva, T. P. (Inst. of Nuclear Research, Novosibirsk, USSR). Prib. Tekh. Eksp., No. 2, 20-6(Mar.-Apr. 1967). (In Russian).

Descriptions are given of a transformer for recording the equilibrium phase of the VEPP-2 (colliding electron-positron beams) storage ring. The transformer combined with a phase meter is capable of recording the changes in the equilibrium phase with an order of accuracy of 0.5^0 and resolving power of 0.1^0. (tr-auth)

40324 HIGH-INTENSITY, RESONATOR-TYPE ELECTRON ACCELERATOR. Iremashvili, D. V.; Leont'ev, N. I.; Plyutto, A. A. (Physical-Technical Inst., Sukhumi, USSR). Prib. Tekh. Eksp., No. 2, 35-40(Mar.-Apr. 1967). (In Russian).

A 1–1.3 MeV resonator-type electron accelerator, yielding beam intensities up to 1000 A in 70 nsec pulses with 1–5 cps repetition frequency, is described. A spark device is used as the electron source. A brief survey of the applications of high-intensity electron accelerators and a short list of such machines already in existence (with beam intensities from 1 to 100 A) are given. A block diagram of the installation shows a rectifier, a pulsed modulation for HF generators (voltage up to 25 kV, power 6MW), an hf generator (frequency 6.3 Mc), a pulsed modulation for the spark source, a programming unit, and a resonator. Essentially, the resonator is a quarter-wavelength, TEM, coaxial-type. The resonator tank is 1.5 m diameter and 3.8 m long; the accelerating gap between the bulge of the internal cylinder and the bottom of the tank is 70 mm wide, which corresponds to a maximum accelerating field of 200 kv/cm. The spark source is located in the bulge of the internal cylinder; high plasma density is achieved through the gradual vaporization of organic-glass material within the path of the spark; the voltage is 1–30 kV, the intensity is up to 3kA, and the pulse duration is 0.5 μsec. The accelerated beam goes through an opening in the tank bottom and falls on the target or into a Faraday cylinder. The vacuum is on the order of 10^{-6} mm Hg. The accelerator has been in operation since the end of 1963. (ATD)

40325 IMPROVED LINEAR ELECTRON ACCELERATOR AT THE INSTITUTE OF ATOMIC ENERGY. Flerov, N. N.; Lipatov, V. P.; Aref'ev, A. V. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 2, 41-5(Mar.-Apr. 1967). (In Russian).

Descriptions are given of an improved linear electron accelerator performing as a pulse source of γ rays and neutrons. The accelerator is capable of performing 100 hr a week with a frequency of 122 pulse/sec and pulse duration of the accelerated electron current of 0.6 and 0.2 μsec. A water moderated uranium target is used as a neutron source. Due to the improvements the neutron source power increased more than five fold and is comprised of $\sim 10^{12}$ neutrons/sec. (tr-auth)

40326 SECTIONAL ACCELERATION TUBE WITH INCLINED FIELDS DESIGNED FOR ELECTROSTATIC ACCELERATORS. Serbinov, A. N. (Inst. of Physics and Power Engineering, Obninsk, USSR). Prib. Tekh. Eksp., No. 2, 30-2 (Mar.-Apr. 1967). (In Russian).

The specifications are given of a sectional accelerator tube consisting of two three-element sections in which accelerated particle flight time through the elements equal to t, 2t, and t respectively. The conditions for which the length of the trisectional element is a minimum were found. (tr-auth)

40327 PRODUCTION OF MONOCHROMATIC γ-QUANTA BY MEANS OF THE STORAGE RING. Korobeinikov, L. S.; Kurdadze, L. M.; Onuchin, A. P.; Popov, S. G.; Tumaikin, G. M. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz., 6: 84-9 (July 1967). (In Russian).

A monochromatic photon beam was obtained using the VEP-1 storage ring by extracting a narrow energy band from the bremsstrahlung spectrum. The target and the secondary-electron counter were placed in the storage-ring magnetic field. The measurements were made at the electron energy of 43, 70, 100 and 135 MeV and with the target thickness of $1/_{10}$ and $1/_{100}$ radiation length. The photon counting rate and the angular spread of the beam agree with the calculations. This photon beam was used to calibrate the total absorption counters used in the double-bremsstrahlung experiment. (tr-auth)

40328 A HIGH POWER SYMMETRICAL COCKCROFT–WALTON TYPE VOLTAGE MULTIPLIER CIRCUIT USING SILICON DIODES. Hara, E. (Hitachi Central Research Lab., Tokyo). Nucl. Instrum. Methods, 54: 91-7(Sept. 1967).

A 200 kV, 200 mA dc power supply for charged particle accelerators is described. It will be used eventually for accelerating a mixture of deuterium and tritium ions to obtain a high intensity neutron flux. The rectifier circuit is a 3 stage symmetrical Cockcroft–Walton type voltage multiplier using small silicon diodes driven by a 1 kC ac power source. The voltage drop in the rectifier circuit is only 7.7 kV at 200 mA, and the ripple voltage is 5.0 V/mA. (auth)

40329 NEW METHOD OF THE RECTILINEAR STRIP BEAM FORMATION UNDER SPACE-CHARGE CONDITION. Nakai, A. (Electrotechnical Lab., Tokyo). Nucl. Instrum. Methods, 54: 57-60(Sept. 1967).

A new method is presented to eliminate the undesirable end-effect appearing in the formation of a strip beam of charged particles according to the Pierce theory, without any additional device. By this method, a beam with finite length can be formed, regarding the cross section of the beam reasonably as a thin ellipse. An analytical solution is given for a rectilinear elliptic beam formation. It is troublesome, however, to perform the complete evaluation of the solution, but an approximation is also presented with sufficient accuracy. (auth)

40330 PREPARATION OF RHENIUM TARGETS USING THE FLORIDA STATE UNIVERSITY ISOTOPE SEPARATOR. Chellis, K. E.; Sheline, R. K. (Florida State Univ., Tallahassee). Contract AT(40-1)-2434. Nucl. Instrum. Methods, 54: 139-40 (Sept. 1967).

^{185}Re and ^{187}Re targets were prepared on carbon backings using a flow of O_2 over rhenium filaments. Resolutions observed in (d,p) reactions indicate the quality of the targets is excellent. (auth)

40331 LITHIUM ION SOURCE. Lee, Chul-chu; Ko, Youn-kyu; Kim, Do-kyong (Yonsei Univ., Seoul). New Phys. (Korea), 7: No. 1, 7-12(June 1967).

The lithium ion source was constructed as an ion source for a Cockcroft-Walton accelerator to study nuclear reaction and radiation effects. The details of design and construction of the ion source chamber, in which were installed four tungsten filaments and accelerating electrodes of 4 kV for extraction, and the fabrication process of beta-eucryptite ($Li_2O \cdot Al_2O_3 \cdot 2SiO_2$) as a source material from a mixture of Li_2CO_3, Al_2O_3 and SiO_2 are described here. A maximum ion current of 220 microampere was obtained when the ion extraction voltage was at 4 kV. The ion beam was composed of Li^+ ions by using positive ray analysis apparatus to investigate whether the ion was the lithium ion or not. (auth)

40332 COOLING SYSTEMS FOR PARTICLE ACCELERATORS. Glasscock, D. L.; Lewis, G. T. Jr. (Charles T. Main, Inc., Boston). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-24, 8p., $1.50. (CONF-661102-18). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

Many mechanical systems are encompassed in the design of high-energy particle accelerators. While a number of these are conventional types, the tolerances or operating conditions to which they must be designed may be quite sophisticated. Systems most frequently encountered are cooling water, ventilation and air conditioning, vacuum, and materials handling. The problems associated with the cooling systems are discussed. The source of cooling loads and operating parameters for these systems, together with the problems involved in combining or cascading them into a central system or a series of unitized systems, is reviewed. Ventilation and air-conditioning systems, as applied to the problems peculiar to accelerators, are discussed in a like manner. Air conditioning of space, or comfort cooling, which can be ser-

viced by conventional systems is considered only to the extent of its contribution to the overall heat-removal problem. (auth)

40333 MECHANICAL DESIGN OF THE 20 MeV EMPEROR TANDEM VAN DE GRAAFF ACCELERATOR. Wilson, L. E.; Christofferson, J. (High Voltage Engineering Corp., Burlington, Mass.). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-12, 9p., $1.50. (CONF-661102-32). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

The Van de Graaff principle is briefly explained as a prerequisite to the discussion which outlines the design and construction of the 70-ft span insulating support of the MP Nuclear Particle Accelerator. The unique method of suspension is described and the details of construction technique are explained. Several illustrations and photographs to support the discussion are also included. (auth)

40334 METHOD AND APPARATUS FOR ACCELERATING CHARGED PARTICLES. (to The Boeing Co.,). British Patent 1,081,589. Aug. 31, 1967. Priority date Nov. 12, 1964, United States.

An improved method and means for accelerating particles to high energies by making use of compact and simplified apparatus is proposed. The accelerator comprises an apparatus for establishing a high-density cloud of charged particles within an evacuated chamber, a laser source, and means for focusing the beam from the laser on the cloud of particles. The method and apparatus are described in detail. (L.B.S.)

40335 SYSTEM FOR DIRECTING A BEAM OF CHARGED PARTICLES DERIVED FROM A PARTICLE ACCELERATOR. (to CSF-Compagnie Generale De Telegraphie Sans Fil). British Patent 1,080,191. Aug. 23, 1967. Priority date Mar. 24, 1965, France.

A system is described for directing a beam of charged particles derived from a particle accelerator by deflecting it onto a target lying outside the normal path followed by the accelerated beam. The guiding system comprises a combination of two deflecting magnets having lines of force which are parallel but of opposite sense, and one or two quadrupole magnetic lenses. A typical focusing device is provided, which affords a comparable result to such a combination, but with relatively fewer components. (L.B.S.)

40336 STORAGE RING. Blewett, J. P. (to U. S. Atomic Energy Commission). U. S. Patent 3,344,357. Sept. 26, 1967.

A method and an apparatus for stacking and merging high energy beams of charged particles with magnetic particle bending fields are described. Separate function magnets are provided transverse to circulating beams for displacing and maintaining the beams with low energy spread and for selectively merging the beams into a single high density beam. (AEC)

40337 APPARATUS FOR THE ACCELERATION, STORAGE, AND UTILIZATION OF COUNTER-ROTATING CHARGED PARTICLE BEAMS. Gordon, Hayden S. (to U. S. Atomic Energy Commission). U. S. Patent 3,343,020. Sept. 19, 1967.

A proton synchrotron for producing and utilizing charged particle beams at the multi-hundred GeV energy level is described. Particles are injected into an accelerator ring in opposite directions during successive half-cycles of the magnet pulsing and the two counter-rotating beams are directed into an adjacent strong focussing dual-orbit storage ring. Special magnet design and coil placement in the storage ring define concentric orbits of systematically varying radius which intersect at an even number of points for the two oppositely directed beams therein. (AEC)

40338 SYSTEM FOR PRODUCING HIGH ENERGY, HIGH INTENSITY CHARGED PARTICLE BEAMS. Rheaume, R. H. (to U. S. Atomic Energy Commission). U. S. Patent 3,343,096. Sept. 19, 1967.

A system is described for producing a high energy, high intensity charged particle beam in a cyclic accelerator with a linear accelerator having a drive saturated, high frequency power amplifier, a hard tube modulator, and means deriving command signals from the cyclic and linear accelerators to produce an input that causes the modulator to control the amplifier for driving the linear accelerator with a signal that corresponds in envelope contour, voltage gradient and repetition rate with the input to the modulator. (AEC)

40339 CERAMIC LOADED BUNCHER FOR LINEAR ACCELERATORS. Loew, Gregory A. (to U. S. Atomic Energy Commission). U. S. Patent 3,336,495. Aug. 15, 1967.

A waveguide provided with an internal ceramic jacket having an aperture that has either a smooth cylindrical surface or a smooth tapered surface for bunching charged particles without generation of space harmonics is described. The dielectric constant of either type of jacket and its dimensions at the particle injection point are such as to enable propagation of rf driving power applied at the injection point to be as a velocity slightly greater than that of the injected particles. The tapered jacket causes the phase velocity of the driving power to increase along the diverging portion of the jacket to accelerate as well as bunch the particles. (AEC)

40340 ACCELERATEURS CIRCULAIRES DE PARTICULES. INTRODUCTION A LA THEORIE. (Circular Particle Accelerators. Introduction to the Theory). Bruck, Henri. Bibliotheque des Sciences et Techniques Nucleaires. Saclay, France, Institut National des Sciences et Techniques Nucleaires and Paris, Presses Universitaires de France, 1966. 368p.

An introduction to the theory of circular particle accelerators is presented. The principal types of circular accelerators are briefly outlined in an introduction. The focusing element, periodic focusing structure, perturbed structure, acceleration, synchrotron radiation and electron dynamics, and high intensity beams are the topics discussed. The essentials of the mathematical results and the formulas used in the description of accelerators are given. (J.S.R.)

40341 PARTIKEL-BESCHLEUNIGER. (Particle-Accelerators). Hanle, D. R.; Pollermann, M. (eds.). Thiemig-Taschenbuecher, Band 28. Munich, Verlag Karl Thiemig KG, 1967. 281p.

The simple accelerators and electron and ion sources most commonly used at the present are described. The topics discussed are electron and ion sources, linear accelerators, circular accelerators, auxiliary devices, accelerator shielding, new developments in particle accelerators, and uses of particle accelerators. This latter includes uses in nuclear physics, preparation of radioisotopes, activation analysis, high energy physics, nondestruction material testing, and therapy. (J.S.R.)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 39821, 40369, 40399, 40432, 40560, 40594, and 40675.

40342 (GA-7959) DIFFERENTIAL NEUTRON THERMALIZATION. Quarterly Technical Report, January 1, 1967–March 31, 1967. Whittemore, W. L. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Apr. 28, 1967. Contract AT-(04-3)-167. 35p. Dep. CFSTI.

Results of research on neutron scattering by liquid D_2O and reactor-grade graphite are reported. The analysis of results and comparisons made using the computer code GASKET are included. The results indicate justification of the aggregate model for liquid D_2O used in calculations by McMurry (Idaho Nuclear Corporation document No. IN-1020, Aug. 1966). Results on the upper cutoff in the frequency distribution for graphite were computed from GASKET and were found to compare favorably with measured results. (S.F.L.)

40343 (JINR-P3-3413) RASSEYANIE ELEKTRONVOL'TNYKH NEITRONOV MOLEKULAMI VODY. (Scattering of the eV Neutrons by Water Molecules). Samosvat, G. S.; Sayasov, Yu. S.; Chuburkov, V. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1967. 15p. (In Russian).
Dep.

A doubly differential cross section of neutron scattering by molecules was measured using a method based on fixing the final energy of the scattered neutrons by a resonance detector (neutron resonance of gold at an energy 4.91 eV was used). The results of the measurement of scattering by water confirm a model, according to which the bound nucleus behaves itself as a quasi-free one while scattering eV neutrons. (auth)

40344 (KAPL-P-3365) MULTIGROUP TWO-DIMENSIONAL NEUTRON TRANSPORT. Crawford, Bruce W.; Friedman, Jack P. (Knolls Atomic Power Lab., Schenectady, N. Y.). [1966]. Contract W-31-109-eng-52. 27p. (CONF-670602-25). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

A multigroup formulation of the two-dimensional transport equation with forward and isotropic scattering components is presented together with applications of the iterative method for solving the equation. (D.C.W.)

40345 (NP-16975) KWIC INDEX OF NUCLEAR PROGRAMMES. (ENEA Computer Programme Library, Ispra (Italy)). June 1967. 135p. Dep.

A brief description is given, in KWIC form, of all the programs which are now in the ENEA library and of some programs of general interest which have been offered to the library. Reference material is included with each KWIC entry. (D.C.W.)

40346 (RPI-328-87, pp 22-59) FAST NEUTRON SPECTRUM PROGRAM. (Rensselaer Polytechnic Inst., Troy, N. Y.).

Information is given on the design and development of a spherical lead electron target for use as the neutron source in fast assemblies. Measurements were made of the neutron spectrum from a $40 \times 40 \times 38$ in.^{3} iron assembly pulsed with the lead target. The spectrum of neutrons from several re-entrant holes in the iron assembly were measured by time-of-flight using a $^{10}B_4C$–Na2 detector. An effort was made to formulate the adjoint fast reactor spectrum, and an application is given for a representative oxide core. A variational principle is developed for the determination of decay constants in pulsed fast neutron assemblies. A group constants averaging procedure for few-group importance-function and reactivity calculations in fast reactors is presented. A six-group importance function calculation is given in graphical form for GODIVA using importance-averaged and flux-averaged group constants. (S.F.L.)

40347 (RPI-328-87, pp 60-72) NEUTRON THERMALIZATION. (Rensselaer Polytechnic Inst., Troy, N. Y.).

Measurements were made of time-dependent neutron leakage spectra as a function of material, temperature, buckling, and absorption using a Be crystal spectrometer. Data are given for lucite, polyethylene, solid ammonia, water, and zirconium hydride. (S.F.L.)

40348 (RPI-328-87, pp 73-85) LOW ENERGY NEUTRON INELASTIC SCATTERING (LENIS). (Rensselaer Polytechnic Inst., Troy, N. Y.).

Low energy neutron inelastic scattering data were obtained for water using a 10-mil thick plane sample having 95% transmission at 0.15 eV. Results are given as differential cross section (per molecule) vs scattered neutron energy. Differential inelastic scattering cross sections are given for niobium hydride, NbH, at 0.238 eV and for uranium dioxide at 0.134 and 0.332 eV. (S.F.L.)

40349 (WASH-1078) COMPILATION OF REQUESTS FOR NUCLEAR CROSS SECTION MEASUREMENTS. Smith, A. B. (comp.) (European-American Nuclear Data Committee). June 1967. 107p. (EANDC(US)-103U). Dep. CFSTI.

A compilation of requests for cross-section measurements is presented. Procedures for making requests, the screening of requests, and the transmittal of data are briefly discussed. (D.C.W.)

40350 INVESTIGATION OF BOUNDARY CONDITIONS FOR P_3-APPROXIMATION IN SPHERICAL GEOMETRY. Rumyantsev, G. Ya.; Shulepin, V. S. At. Energ. (USSR), 22: 316-17(Apr. 1967). (In Russian).

The P_3 approximation of neutron diffusion in a nuclear reactor is more accurate than a P_1 approximation and not as cumbersome as a P_3 approximation. The accuracy of a P_2 approximation having certain boundary conditions of continuity is investigated by calculating the critical radius of the active zone of a spherical reactor with an infinite reflector and comparing this value with the corresponding value obtained by a P_3 approximation. The P_2 approximation with the constant coefficients $\alpha = 2$ and $\beta = 1$ gives good results when the total cross section of the medium is due to scattering and fission and other contributions are small. (TTT)

40351 EXPERIMENTAL STUDY OF INTERACTION IN ARRAY OF FISSILE SPHERES. Kuvshinov, M. I.; Stsiborskii, B. D. At. Energ. (USSR), 22: 312-13(Apr. 1967). (In Russian).

The angular distribution of neutrons emerging from a sphere of Oralloy-90 (metallic uranium containing 90% ^{235}U) and the critical mass of two interacting spheres of Oralloy-90 were measured. The following assemblies were investigated: a solid sphere 13.5 cm in dia without a reflector; a solid sphere 15.1 cm in dia without a reflector; a solid sphere 16.7 cm in dia without reflector; a sphere 18.3 cm in dia with a hole 6.3 cm in dia in the center without a reflector; and a sphere 16.7 cm in dia with a hole 2.8 cm in dia in the center surrounded with an aluminum shell 30 cm in dia. A Po neutron source was placed outside the sphere at a distance L from the center of the sphere at various angles between the neutron detector and the sphere. The neutron multiplying coefficient and the average cosine of the angular neutron distribution were determined. A neutron source in the center of one sphere, and the other sphere were rigidly fixed at a distance L. By measuring the neutron flux from such a system and extrapolating the data to the critical state, it was found that the critical distance L was equal to 18.3 cm and L = 25 cm described above. (TTT)

40352 DYNAMICS OF LIQUID CD_4 FROM COLD-NEUTRON SCATTERING. Venkataraman, G.; Dasannacharya, B. A.; Rao, K. R. (Bhabha Atomic Research Centre, Trombay, India). Phys. Rev., 161: 133-42(Sept. 5, 1967). (BARC-286).

The scattering of 4.1 Å neutrons by liquid CD_4 at 95°K has been studied at several angles of scattering covering the first liquid diffraction peak. The spectra are strikingly different from those observed in liquid CH_4, with the quasi-elastic peak being very much more prominent than in liquid CH_4 at large scattering angles. The width of the quasi-elastic peak shows an oscillatory behavior as a function of momentum transfer, with a minimum at the diffraction peak. Expressions are derived for the scattering of slow neutrons by a monomolecular system under the assumption of no vibrational scattering and weak anisotropic forces. In applying the theory to liquid CD_4, two models (A and B) are considered. In both models, the single-particle translational motions are assumed to have a simple diffusion behavior, while collective motions are described by an intermediate scattering function with a structure-dependent damping. The rotations are treated as free in model A and as hindered in model B. The first- and second-order relaxation functions for the hindered rotator, are derived from infrared and Raman data, respectively, as suggested by Sears. Both models make essentially the same predictions for the quasi-elastic widths, and these are found to be in fair agreement with experiment. Examination of the various contributions to the total spectrum in both models shows that the differences in the spectra for CD_4 and CH_4 are partly due to intramolecular effects which reduce the rotational inelastic intensity and enhance the quasielastic, and partly due to intermolecular effects which also boost the quasi-elastic intensity.

It is further found that spectra predicted by the two models are very nearly the same, unlike the case of liquid CH_4, where hindering of the rotation influences the spectrum considerably. This is a consequence of the fact that rotational effects appear mainly via incoherent scattering, which is small in the case of CD_4. Comparison with experiment shows that our models are able to explain qualitatively the important differences between the spectra for CH_4 and CD_4. Quantitative agreement is, however, lacking, and this indicates the need for improved models for the center-of-mass motions. (auth)

40353 ONE-SPEED NEUTRON TRANSPORT IN SLAB GEOMETRY. Pahor, S. (Univ. of Ljubljana, Yugoslavia). Nucl. Sci. Eng., 29: 248-53(Aug. 1967).

Linear integral equations for Chandrasekhar's S and T functions are derived from the solution for the half-space albedo problem by using the principles of invariance. This procedure is a generalization of the method by which the thickslab asymptotic solutions for the S and T functions are obtained by combining the solutions for the half-space ordinary Milne and albedo problems. Approximate solutions can be calculated by iteration. Explicit expressions for the zero'th-order approximations are given in terms of Ambarzumian–Chandrasekhar's H function, and Busbridge's q polynomials. Case's full-range normal mode expansion is then applied to find the approximate solutions for the albedo problem. The method by which the approximate solutions for the Green's function problem can be obtained is also indicated. (auth)

40354 MULTI-PARAMETER REPRESENTATION OF HIGHLY HARDENED THERMAL NEUTRON SPECTRA. Albert, D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 10: 39-44(Feb. 1967). (In German).

The manner in which neutron spectra and especially hardened thermal neutron spectra can be comprehended approximately by spectral models was introduced. Spectrum models which contain several free parameters were proposed and discussed. It was shown how one can evaluate integral measurements with Lu, Eu, and ^{239}Pu as non-1/v indicators with respect to spectrum parameters. (tr-auth)

40355 DISAPPEARANCE OF DISCRETE EIGENVALUES OF THE TRANSPORT OPERATOR IN PLANE GEOMETRY. Mika, Janusz; Stankiewicz, Roman (Inst. of Nuclear Research, Polish Academy of Sciences, Swierk). Nukleonik, 10: 88(July 1967).

A simple proof that the discrete eigenvalues disappear for a sufficiently small slab thickness is presented. (D.C.W.)

40356 MILNE'S PROBLEM FOR A PLANE SLAB WITH CONSTANT SOURCE BOUNDED BY HOMOGENEOUS MATTER. Korn, Axel (Technische Hochschule, Karlsruhe, Ger.). Nukleonik, 10: 78-81(July 1967).

Exact expressions are derived for the neutron current and neutron density within an infinitely extended slab of thickness 2d. It is supposed that the slab sustains a uniform source of neutrons and that all neutrons have the same velocity. The slab shall be bounded by a homogeneous medium on both sides. The scattering of the neutrons is assumed to be linear anisotropic. Current and density are given by a series which converges faster than an exponential series. (auth)

40357 A REMARK ON THE ROSSI-α EXPERIMENT. Iijima, Tsutomu (Japan Atomic Energy Research Inst., Tokyo). Nukleonik, 10: 93-4(July 1967).

An analysis of the probabilities for the production of a count in a given time interval is made using the point reactor model and one-group theory in order to determine if the quantity measured by the usual method of Rossi-α experiments is really the amplitude of the correlation term as given by Orndoff's theory. It is shown that the amplitude of the correlation term changes as a function of the time from the origin of the chain to the trigger pulse and that the conditional probability is not the same for all trigger pulses. (D.C.W.)

40358 LOCAL PILE OSCILLATOR AS A DEVICE FOR MEASURING EPITHERMAL NEUTRON ABSORPTION. Dekker, A. L.; Kleijn, H. R. (Delft Technological Univ., Netherlands). Nucl. Instrum. Methods, 55: 87-92(Sept. 1967).

A local oscillator is described which is modified for operation in the epithermal region. Reduction of the results to effective resonance integrals, and determination of the cadmium cut off energy are discussed. Attention is given to the construction of the detector and associated electronics. (auth)

40359 4π NEUTRON SOURCE TECHNIQUE FOR NEUTRON SCATTERING MEASUREMENTS. Sauter, G. D.; Bowman, C. D. (Univ. of California, Livermore). Contract W-7405-eng-48. Nucl. Instrum. Methods, 55: 141-50(Sept. 1967). (UCRL-70408).

A new time-of-flight technique for measuring neutron scattering cross sections, which is particularly valuable for fissile samples, was developed. By means of a spatially uniform 4π neutron source, it is possible to place the neutron detector far from the scattering sample. With this geometry, the background associated with the neutron-induced capture and fission reactions can be completely separated from the scattered neutron signal. The reduction in background rate is adequate for performing scattering measurements on the common fissile nuclides. The larger separation between the neutron detector and the scattering sample also permits measurements on very radioactive samples. (auth)

40360 ON THE TWO-POINT APPROXIMATION EQUATION OF REACTOR KINETICS. Asahi, Yoshiro; An, Shigehiro; Oyama, Akira (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo), 4: 315-17(June 1967).

A set of kinetic equations with time-dependent coupling coefficients within the validity of the perturbation theory for loosely and tightly coupled reactors with identical two-slab cores is discussed. It is shown that time dependency of coupling reactivity is related to the higher modes of excitation. (S.F.L.)

40361 MEASUREMENT OF CADMIUM RATIO IN A U–H_2O SUBCRITICAL ASSEMBLY WITH SCINTILLATION DETECTOR. Tojo, Takao (Japan Atomic Energy Research Inst., Tokyo); Niwa, Takeo; Nakajima, Tadashi; Kondo, Makoto. J. Nucl. Sci. Technol. (Tokyo), 4: 314-15(June 1967).

The cadmium ratio was measured in a water-moderated uranium subcritical assembly with a detector consisting of ^6LiF and ZnS(Ag) scintillator, a light guide of acrylite, and an RCA 6810A photomultiplier. Experimental points were obtained with the detector positioned in the water between fuel rods, and with the fuel neighboring the center fuel replaced by an empty fuel tube into which the detector was inserted. (S.F.L.)

40362 A RELATIONSHIP BETWEEN COLLISION PROBABILITIES. Pomraning, G. C. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Nucl. Sci. Technol. (Tokyo), 4: 312-13(June 1967).

Monoenergetic neutron transport within a convex, homogeneous body bounded by a vacuum is considered first by assuming an isotropic, uniformly distributed source of neutrons within the body, and second by assuming the body is immersed in a uniform isotropic neutron bath. Case, de Hoffmann, and Placzek have shown that the 0-th order collision probabilities Γ_0 and γ_0 respectively of these two problems are related according to $\gamma_0 = \bar{l}(1 - \Gamma_0)$ where $\bar{l}$ is the mean optical chord length of the body, defined as $\bar{l} = 4V\Sigma/S$. A generalization of this equation to capture, rather than collision, probabilities has been known for some time and is given by $\gamma = \bar{l}(1 - C)(1 - \Gamma)$, where $C = \Sigma_s/\Sigma$ is the mean number of secondaries per collision. It is shown that a generalization of the first equation to n-th order collision probabilities can easily be made by using the second equation, involving capture probabilities. (S.F.L.)

40363 NEUTRON SPECTROMETRY. Cranberg, Lawrence (Univ. of Virginia, Charlottesville). Phys. Today, 20: 39-43 (Aug. 1967).

The development of instrumentation and methods for neutron spectrometry is briefly reviewed with emphasis on the problems of neutron spectrometry. The status of neutron spectrometry is indicated. (D.C.W.)

40364 THE EXTRAPOLATED ENDPOINT FOR THE MILNE PROBLEM. Pomraning, G. C. (General Atomic Div., General Dynamics Corp., San Diego, Calif.); Lathrop, K. D. Nucl. Sci. Eng., 29: 305-8(Aug. 1967).

Upper and lower bounds on the extrapolated endpoint for a homogeneous source-free half-space with absorption and isotropic scattering are calculated by relating the extrapolated endpoint to a linear functional and applying variational methods. (D.C.W.)

40365 A DERIVATION OF VARIATIONAL PRINCIPLES FOR INHOMOGENEOUS EQUATIONS. Pomraning, G. C. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 29: 220-36 (Aug. 1967). (BNL-10514)

It is shown that variational principles need not be postulated and then correctness proved; they can, in fact, be derived, making their use more a matter of routine than ingenuity. A Lagrange multiplier technique is used to derive a second-order variational principle for estimating an arbitrary functional of the solution to an inhomogeneous equation. The relation of this principle to a functional Taylor series expansion and to elementary perturbation theory is established. A normalization independent second-order variational principle for an arbitrary functional is derived which reduces to the Schwinger principle if the functional is linear. Two higher-order variational principles are derived and are shown to be generalizations of the principles of Kostin and Brooks. The Lagrange multiplier technique is applied to the inhomogeneous Sturm-Liouville equation, which leads to a second-order varia-

tional principle for estimating an arbitrary functional which allows trial functions that are not continuous and do not satisfy the boundary conditions. This functional is of the type suggested by Buslik plus boundary terms. The differences between a variational principle which can only be used to estimate a functional of interest and one which also acts as a Lagrangian are discussed. (auth)

40366 THE HARWELL ELECTRON LINEAR ACCELERATOR LABORATORY. Harwell, Eng., United Kingdom Atomic Energy Authority. 12p.

The Electron Linear Accelerator Laboratory at Harwell, which is designed to provide facilities for the study of the interaction of neutrons and photons with matter, is described. A powerful accelerator produces intense pulsed beams of electrons at peak currents up to 1 ampere and electron energies up to 55 MeV. When stopped in heavy element targets these electrons produce intense pulses of bremsstrahlung which can be either used directly in photonuclear and irradiation experiments or absorbed in fissionable material to generate neutrons by photodisintegration and photofission reactions at peak rates reaching 5×10^{16} neutrons/sec. Experiments carried out at the laboratory include the study of the interactions of neutrons with atomic nuclei, the measurement of the energies of neutrons produced in photonuclear interactions, the measurement of neutron spectra, and the elucidation of solid and liquid structure using low-energy neutrons. Most of the experiments employ the time-of-flight method of neutron spectroscopy. Provision is also made for the irradiation of materials with photons in order to study the activities produced. The principal pulsed neutron source, source, known as the Neutron Booster, contains an electron target built inside a subcritical assembly of highly enriched uranium, which enhances the primary neutron yield by a factor of ten to 5×10^{17} neutrons per second during the accelerator pulse. The Neutron Booster is situated at the center of a number of radial flight paths, which permits the simultaneous operation of a large number of neutron time-of-flight experiments. Furthermore, pulses of electrons can be switched, using pulsed magnet deflectors, to other target positions in a programmed sequence, which allows a comprehensive series of experiments to proceed simultaneously. Records of project operation show that over the past three years the accelerator was scheduled to run for 70% of the time and was available for 81% of the scheduled time. (auth) (UK)

Nuclear Properties and Reactions, A≤5

Refer also to abstracts 40378, 40432, and 40481.

40367 TENSOR POLARIZATION OF ^{4}He(d,d)^{4}He DEUTERONS IN THE REGION OF THE 1.07-MeV RESONANCE. Meiner, H.; Baumgartner, E.; Darden, S. E.; Huber, P.; Plattner, G. R. (Univ., Basel). Helv. Phys. Acta, 40: 483-500(1967). (In German).

The tensor polarization of 0.99 to 1.6 MeV deuterons, scattered elastically from ^{4}He, was measured using the ^{3}He(d,p)^{4}He reaction as analyzer. A phaseshift analysis of differential cross sections and angular distributions of the tensor moments of deuteron polarization was performed and yielded satisfactory fits, joining smoothly the values of McIntyre [Nucl. Phys. A91, 369-82 (1967)] from 2 to 8 MeV. The resonant phase at $E_d = 1.071$ MeV confirms that this level has $J^\pi = 3^+$ and yields a reduced width of $\gamma^2 = 0.55$ MeV. (auth)

40368 $\alpha-\alpha$ INTERACTION AT HIGH ENERGIES. Abe, Yasuhisa; Endo, Osamu; Tamagaki, Ryozo (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto), 37: 1116-30(June 1967).

It is shown that the inside repulsive core of the $\alpha-\alpha$ interaction appearing in the effective potential description at low energies, turns strongly absorptive at very high energies. The impulse approximation is used to construct an $\alpha-\alpha$ optical potential at high energies from two-nucleon scattering amplitudes. By comparison with the elastic scattering data at 915 MeV, the qualitative properties if the $\alpha-\alpha$ optical potential thus derived are confirmed as reliable. Also, it is shown that the effects of target exchange terms give no essential modification to this potential. (auth)

40369 SLOW POSITIVE-PION CAPTURE BY ^{3}He AND PAIR-CORRELATION EFFECTS. Sakamoto, Yoshiyuki; Tohsaki, Akihiro (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 37: 1100-15(June 1967).

The wave function of ^{3}He is assumed to be a Gaussian form with correlation between nucleons. The interaction Hamiltonian of the pion capture is taken as the sum of the π-N interaction operators. The total cross sections of the capture and momentum spectra of protons are calculated. The total cross section is also calculated by means of the phenomenological amplitudes determined by analyzing the data of $p + p \rightarrow d + \pi^+$ and $p + p \rightarrow p + p + \pi^0$ reactions. It is shown that the comparison of both the results determines the parameter in the correlation function of the nucleon pair. (auth)

40370 RADIATIVE CAPTURE OF ^{3}He BY ^{3}He. Harrison, W. D.; Stephens, W. E.; Tombrello, T. A.; Winkler, H. (California Inst. of Tech., Pasadena). Phys. Rev., 160: 752-5(Aug. 20, 1967).

The reaction $^3\text{He} + {}^3\text{He} \rightarrow {}^6\text{Be}^* + \gamma$ was observed at 90° for bombarding energies between 0.86 and 11.8 MeV. The total cross section for transitions to the first excited state of ^{6}Be varies smoothly from 0.4 to 9.3 μb (assuming isotropy). No γ-ray transitions to the ground state of ^{6}Be were observed with an upper limit of approximately 10^{-2} μb at 1.4 MeV. Because of these low cross sections, this reaction is of negligible astrophysical importance compared to the ^{3}He(^{3}He,2p)^{4}He reaction. (auth)

40371 STRUCTURE OF THE ^{4}He NUCLEUS FROM ELASTIC ELECTRON SCATTERING. Frosch, R. F.; McCarthy, J. S.; Rand, R. E.; Yearian, M. R. (Stanford Univ., Calif.). Phys. Rev., 160: 874-79(Aug. 20, 1967).

The cross section for elastic electron scattering from ^{4}He at values of q^2, the four-momentum transfer squared, ranging from 0.5 to 20.0 F^{-2} was measured. Previous Stanford measurements extended up to $q^2 = 6.2$ F^{-2} and were consistent with a Gaussian shape for the charge distribution of the ^{4}He nucleus. The results confirm the earlier data but show a deviation from the Gaussian model for $q^2 > 6$ F^{-2}. At $q^2 = 10$ F^{-2} a diffraction minimum of the scattering cross section was observed. Among the models which were found to fit the new data is the Fermi three-parameter charge distribution. The rms radius $\langle r^2 \rangle^{1/2}$, the half-density radius $r_{1/2}$, and the 90% to 10% skin thickness t of the charge distribution were calculated for the models which adequately fit the data. The results indicate that the surface of the ^{4}He charge distribution is less diffuse than implied by the nuclear harmonic-oscillator model. (auth)

40372 ONE-POLE APPROXIMATION IN THE ELASTIC SCATTERING OF COMPOSITE PARTICLES. Fishbane, P. M. (Princeton Univ., N. J.); Noble, J. V. Phys. Rev., 160: 880-2(Aug. 20, 1967).

Deuteron-alpha scattering, a physical system in which the small separation between elastic and inelastic (breakup) thresholds can lead to observable consequences, is studied. Taking into account the three-body channel, an approximate dispersion relation for the elastic amplitude is derived and solved in the one-pole approximation. Internal consistency is tested by fitting the pole parameters to the ^{6}Li binding energy and the d-α scattering length in the $J^\pi = 1^+$ channel, and to the position and width of the ^{6}Li resonance in the 3^+ channel. The corresponding phase shifts are then calculated and compared with the experimental values, obtaining good agreement. The good agreement of this fit gives confidence in subsequent assessment of the qualitative influence of the nearby three-particle inelastic channel on the (two-body) elastic scattering amplitude. (auth)

40373 COMPARISON PROCEDURE AND THE NEUTRON-NEUTRON SCATTERING LENGTH. van Oers, W. T. H.; Slaus, I. (Univ. of California, Los Angeles). Phys. Rev., 160: 853-66(Aug. 20, 1967).

At present the only means for obtaining information about the neutron-neutron scattering length a_{nn} and effective range r_0 are studies of reactions with three or more particles in the final state. It was felt that the comparative analysis of the various reactions which exhibit a $^1S_0$ nucleon-nucleon interaction in the final state would be a reliable procedure by which to extract a_{nn}. Thus the nucleon-induced breakup reactions of deuterons and trions were analyzed using the Born approximation and S-state wave functions for the deuteron, the trion and the two nucleons having a low relative energy in the final state. The comparative analysis of the trion breakup processes was found unsuccessful in the energy range considered. The values for a_{nn} extracted in analyses of the reaction D(n,p)2n around 14 MeV cannot be reconciled with the theoretical predictions based on exact charge symmetry and using either a hard-core or a velocity-dependent potential. The present analysis indicates, however, that for incident energies larger than 30 MeV the distorting interference effects are removed and that the deuteron breakup processes become more promising for the determination of a_{nn}. (auth)

Nuclear Properties and Reactions, 6≤A≤19

Refer also to abstracts 40144, 40432, 40463, 40501, 40516, and 40675.

40374 (COO-1420-134) RESEARCH IN NUCLEAR PHYSICS. Progress Report No. 17. Steffen, R. M. (Purdue Research Foundation, Lafayette, Ind.). June 15, 1967. Contract AT-(11-1)-1420. 81p. Dep. CFSTI.

NITROGEN-14—alpha elastic scattering at 19.2 MeV, optical-model parameters for, (E/T)
OXYGEN-16—helium-3 elastic scattering at 13.95 MeV, optical-model parameters for, (E/T)
ALPHA PARTICLES—scattering by carbon-12 at 18 MeV, optical-model parameters for elastic, (E/T); scattering by nitrogen-14 at 19.2 MeV, optical-model parameters for elastic, (E/T)
HELIUM-3—scattering by carbon 12, nitrogen-14, and oxygen-16 at 13.95 MeV, optical-model parameters for, (E/T)
CADMIUM-114—energy levels from inelastic scattering of oxygen-16 ions, (E)
SAMARIUM-152, GADOLINIUM-154—internal-conversion electron particle parameters for E2 transitions in, (E)
THULIUM-169, LEAD-207—internal-conversion electron particle parameters for,
ANTIMONY-124—beta decay of, beta-gamma directional correlations in, (E)
YTTERBIUM-169—electron-capture decay of, thulium-169 energy levels from, (E)
IRON—internal magnetic fields at various atoms embedded in, (E)
HAFNIUM—internal magnetic field at nuclei of, embedded in ferromagnetic lattice
PLATINUM-192—gyromagnetic ratios of energy levels in, (E)
FERROMAGNETIC MATERIALS—internal hyperfine magnetic fields at impurities imbedded in, (E)
EUROPIUM-152, TANTALUM-182—gamma cascades in, directional correlations of, (E) (S.F.L.)

40375 EFFECT OF THE RESONANCE AT 2.65 MeV ON THE REACTION $^{11}B + p \rightarrow 3\alpha$. Flamant, Yves; Chanut, Yves; Bouabdallah, Fethi; Ballini, Rene; Marquez, Luis (CEN, Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B. 264: 1283-5-(Apr. 24, 1967). (In French).

Some data on the resonance of $^{11}B + p$ at 2.65 MeV were obtained beginning with the decay into three α particles, of which one has an energy close to zero. (tr-auth)

40376 MEASUREMENT OF THE VECTOR ANALYZING POWER OF THE REACTION $^6Li(d,\alpha)^4He$ FOR INCIDENT POLARIZED DEUTERONS IN THE ENERGY REGION BETWEEN 0.7 AND 2.2 MeV. Plattner, G. R.; Baumgartner, E.; Darden, S. E.; Meiner, H.; Seiler, F. (Univ., Basel). Helv. Phys. Acta, 40: 465-82(1967). (In German).

The vector analyzing power of the $^6Li(d,\alpha)^4He$ reaction for polarized deuterons was measured from 0.7 to 2.2 MeV in the laboratory, using $^4He(d,d)^4He$ elastic scattering as a polarizer. It can be shown from the results obtained, that the ^8Be compound level at 25.2 MeV excitation energy has $J^\pi = 2^+$ or, much less probably, 4^+. (auth)

40377 HIGH-RESOLUTION FAST-NEUTRON SPECTROSCOPY OF THE REACTION $^9Be(p,n)^9B$ AT 20 MeV. Slobodrian, R. J.; Bichsel, H.; McKee, J. S. C.; Tivol, W. F. (Univ. of California, Berkeley). Contract W-7405-eng-48. Phys. Rev. Lett., 19: 595-7(Sept. 4, 1967). (UCRL-17507).

High-resolution fast-neutron spectra (to about 1%) were obtained by means of the proton-radiator method, detecting the proton recoils with solid-state detector telescopes and particle identifier circuits. The spectra confirm a broad peak at 1.4 MeV and resolve another at 3.2-MeV excitation. (auth)

40378 ELECTRODISINTEGRATION OF ^{12}C. Afanas'ev, N. G.; Gol'dshtein, V. A.; Dementii, S. V.; Vlasenko, V. G.; Arkatov, I. M.; Titov, Yu. I. Yadern. Fiz., 5: 1134-5(May 1967). (In Russian).

The electrodisintegration of ^{12}C was studied on the 2-GeV linear accelerator of the Physico-Technical Institute of the Ukrainian Academy of Sciences, measuring the σ_C/σ_p ratio, where σ_C represents the cross section of the electrodisintegration process for carbon at the maximum of the peak and σ_p is the elastic scattering cross section of electrons by protons. The work involved determination of the spectra of electrons scattered on carbon and polyethylene targets by means of a homogeneous-field, double-focusing spectrometer and Cherenkov detectors. The charge passing through the target was measured by means of a secondary emission monitor. The spectrum obtained with the polyethylene target was used to calculate the carbon background, separating out the peaks corresponding to the elastic scattering on protons. Graphs were prepared for the spectra of electrons scattered at 23, 35, and 45° on protons and carbon with an initial electron energy of 8.46 MeV. (auth)

40379 ELASTIC AND INELASTIC SCATTERING OF α-PARTICLES WITH ENERGY 33.4 MeV ON ^{12}C AND ^{13}C. Artemov, K. P.; Gol'dberg, V. Z.; Rudakov, V. P.; Serikov, I. N. Yadern. Fiz., 6: 13-16(July 1967). (In Russian).

Angular distributions of α particles were measured in elastic and inelastic α scattering on ^{12}C and ^{13}C. The results obtained give evidence that one of the ^{13}C doublet levels (7.50 and 7.55 MeV) has the quantum numbers $\frac{5}{2}^-$. (auth)

40380 PHOTOPROTONS FROM $^{16}O(\gamma,p)^{15}N$ REACTION AT A GAMMA ENERGY OF 21.7 MeV. Tutakin, P. M. Yadern. Fiz., 5: 1325-6(June 1967). (In Russian).

The energy and angular distributions of photoprotons from the reaction were determined with the use of photofilm and monoenergetic gamma rays from the $T(p,\gamma)^4He$ reaction. The number of photoproton tracks was plotted as a function of photoproton energy E_p. The peak at E_p = 9.5 MeV corresponded to the decay of excited ^{16}O to the ground state of ^{15}N, and the peak at E_p = 2.5 to 4.0 corresponded to the decay of excited ^{16}O to states having energies of 6.33 and 7.33 MeV. The number of photoproton tracks at E_p = 8.7 to 10.2 MeV showed a sharp directional bias forward and backwards: 134 at 0 to 10°, 203 at 10 to 20°, 67 at 20 to 30°, 51 at 30 to 40°, 39 at 40 to 50°, 24 at 50 to 60°, 16 at 60 to 70°, 14 at 70 to 80°, and 25 phototracks at 80 to 90°. (TTT)

40381 BREAKUP OF ^{16}O INTO $^8Be + ^8Be$. Chevallier, P. (Institut de Recherches Nucleaires, Strasbourg-Cronenbourg, France); Scheibling, F.; Goldring, G.; Plesser, I.; Sachs, M. W. Phys. Rev., 160: 827-34(Aug. 20, 1967).

The reaction $^{12}C + \alpha \rightarrow ^8Be + ^8Be$ was studied in the range of α energy 11.85 MeV $\leq E_{\alpha\,in} \leq$ 19.4 MeV. The ^8Be nuclei were detected by a suitable counter system registering the α-particle decay products. The cross section for this reaction was found to be quite large. A number of resonances were identified, and their spins and parities were determined by angular-distribution measurements. There is an indication of a rotational-band pattern of some of the levels. (auth)

40382 ENERGY DEPENDENCE OF THE $^{10}B(^6Li,\alpha)^{12}C$ AND $^9Be(^6Li,p)^{14}C$ REACTION CROSS SECTIONS. Seale, Wayne A. (Univ. of Iowa, Iowa City). Phys. Rev., 160: 809-15(Aug. 20, 1967).

The cross sections of the reactions $^{10}B(^6Li,\alpha_0)^{12}C$ and $^{10}B(^6Li,\alpha_1)^{12*}C$ were measured at 0° for ^6Li energies of 3.20 to 13.60 MeV. The $^9Be(^6Li,p_0)^{14}C$ and $^9Be(^6Li,p_1)^{14*}C$ cross sections at 0° were measured for ^6Li energies ranging from 3.84 to 6.40 MeV. The analysis of the yield curves in terms of Ericson fluctuation theory gave values of the average level width, Γ, of 1.40 MeV for ^{16}O at 36-MeV excitation and approximately 0.40 MeV for ^{15}N at 28-MeV excitation. From the same data it was found that there is a considerable contribution of direct reaction mechanism as well as compound nucleus to both reactions. (auth)

40383 SCATTERING OF ALPHA PARTICLES BY OXYGEN. I. BOMBARDING ENERGY RANGE 5.8 TO 10.0 MeV. Hunt, W. E.; Mehta, M. K.; Davis, R. H. (Florida State Univ., Tallahassee). Phys. Rev., 160: 782-90(Aug. 20, 1967).

Absolute differential cross sections for the elastic scattering of α particles by ^{16}O were measured as a function of bombarding energy in the range 5.8 to 10.0 MeV. Measurements were made at center-of-mass angles of 90.0°, 109.9°, 114.0°, 125.3°, 131.4°, 140.8°, 149.4°, 154.0°, 158.8°, and 163.8°. Detailed angular distributions were measured at 6.97, 8.63, and 9.92 MeV (lab). Sixteen resonances were observed corresponding to energy levels in ^{20}Ne at 9.50, 9.99, 10.30, 10.49, 10.55, ~10.7, 10.83, (10.93), 11.03, 11.29, ~11.6, (11.89), 11.99, 12.27, 12.39, and 12.58 MeV (c.m.) Spin and parity assignments were made for six of these levels, tentative assignments are suggested for seven, and two or more possible assignments are given for two levels. Phase shifts were extracted from the angular distribution data at 6.97, 8.63, and 9.92 MeV (lab). New rotational bands in ^{20}Ne are suggested by the data and previously reported bands were extended. Information about the levels in ^{20}Ne is compared with that obtained in previous studies of other nuclear reactions. The correspondence with the results of an $^{16}O(\alpha,\gamma)^{20}Ne$ investigation is generally good. The set of ^{20}Ne levels found in this work is somewhat different from the set determined by the $^{12}C(^{12}C,\alpha)^{20}Ne$ reaction experiments, and this difference is discussed. (auth)

40384 SCATTERING OF ALPHA PARTICLES BY OXYGEN. II. BOMBARDING ENERGY RANGE 10 TO 19 MeV. Mehta, M. K.; Hunt, W. E.; Davis, R. H. (Florida State Univ., Tallahassee). Phys. Rev., 160: 791-802(Aug. 20, 1967).

The $^{16}O(\alpha,\alpha)^{16}O$ and $^{16}O(\alpha,\alpha')^{16}O$ reactions were studied in the bombarding energy range from 10.0 to 19.0 MeV. Elastic-scattering differential cross sections were measured at eight angles as a function of energy, and a total of thirty-five levels in the compound nucleus ^{20}Ne were observed in the excitation curves.

Angular distributions of the elastically scattered α particles were measured at seven energies and each shows a strong dependence of the differential cross section on angle. These were analyzed in terms of the Ackhiezer-Pomeranchuk-Blair-McIntyre (APBM) model. Good theoretical fits to the experimental data were obtained only when contributions from resonances were included explicitly in the APBM-model calculations. Excitation curves for the γ rays emitted from nuclei excited in inelastic-scattering events were measured, and the ^{20}Ne energy levels found in the γ-ray excitation curves confirm most of the levels found in the elastic-scattering experiment. Thin- and thick-target angular distributions for the 6.13-MeV γ rays were measured at 15 energies. Thick-target γ-ray angular distributions which average over many resonances could not be simply interpreted in terms of bread levels in ^{20}Ne. Twenty spin-and-parity assignments to states in ^{20}Ne were made in the analysis of the elastic- and inelastic-scattering data, and of these, 14 are tentative. The levels in ^{20}Ne observed have broader widths, larger spacings, and greater spins than the majority of those reported in the literature for the same excitation energy range. These differences are discussed and a possible explanation is offered. (auth)

40385 ^{14}C(p,n)^{14}N REACTION AND THE TWO-BODY FORCE. Wong, C. (Univ. of California, Livermore); Anderson, J. D.; McClure, J.; Pohl, B.; Madsen, V. A.; Schmittroth, F. Contract W-7405-eng-48. Phys. Rev., 160: 769-74(Aug. 20, 1967). (UCRL-14899).

The ^{14}C(p,n)^{14}N reaction to the ground and first two levels of ^{14}N was investigated for proton energies between 6 and 14 MeV. The angular distributions at the highest energies were analyzed by using a finite range distorted-wave Born-approximation formalism, assuming the two-body force to be of the form $\tau_0 \cdot \tau_1(b + a\sigma_0 \cdot \sigma_1)f(r_{01})$, where τ_0 and σ_0 refer to the isospin and spin of the incident nucleon, τ_1 and σ_1 refer to isospin and spin of the extra-core target nucleons, and $f(r_{01})$ is the Yukawa form factor with a range of 1.4 F. Calculations employing Visscher-Ferrell wave functions for ^{14}C and ^{14}N gave a good fit for the $0^+ \rightarrow 0^+$ transition and a reasonable value for b of 9 MeV. However, the calculations for the $0^+ \rightarrow 1^+$ ground-state and second-excited-state transitions yielded inconsistent values for a of 7 MeV for the excited transition and 21 MeV for the ground-state transition. This latter result is not unexpected, since $(\tau_0 \cdot \tau_1)(\sigma_0 \cdot \sigma_1)$ is related to the Gamow-Teller β-decay operator. The fact that experimentally the (p,n) reaction to the ground state is not inhibited (while the corresponding β decay is strongly suppressed) indicates that the spin and charge-exchange operator is not sufficient to account for the (p,n) ground-state transition. An explanation of the observed ground-state cross section in ^{14}C(p,n) requires additional spin-flip mechanisms such as a tensor interaction or particle exchange. (auth)

40386 MEASUREMENT OF THE MAGNETIC MOMENT AND LIFETIME OF THE 1.131-MeV LEVEL IN ^{18}F. Poletti, A. R. (Brookhaven National Lab., Upton, N. Y.); Fossan, D. B. Contract AT(30 2)-Gen-16. Phys. Rev., 160: 883-8(Aug. 20, 1967). (BNL-11167).

The magnetic moment of the 1.131-MeV level in ^{18}F was measured, using the ^{16}O(^{3}He,p)^{18}F reaction and the differential time-delay technique, as $\mu = +(0.568 \pm 0.013)J$. The mean lifetime of this level was remeasured. The measured magnetic moment agrees, to within the experimental uncertainties, with that predicted by the nuclear shell model for a level of spin-parity 5^+ resulting from the $1d_{\frac{5}{2}}^{-1}$ configuration. Some information is also obtained about the effect on the original nuclear alignment of the stopping process for ^{18}F ions of approximately 1-MeV energy in copper. (auth)

40387 STUDY OF THE ^{18}O(p,t)^{16}O AND ^{18}O(p,d)^{17}O REACTIONS AT E_p = 18.2 MeV. Lutz, H. F.; Wesolowski, J. J.; Eccles, S. F.; Hansen, L. F. (Univ. of California, Livermore). Contract W-7405-eng-48. Nucl. Phys., A101: 241-9(1967). (UCRL-70190).

The nuclear reactions ^{18}O(p,t)^{16}O and ^{18}O(p,d)^{17}O were studied at E_p = 18.2 MeV. A gas target of enriched ^{18}O was used. Triton groups corresponding to the ground state of ^{16}O, 6.05–6.13 (unresolved), 6.92, 7.12, and 8.88 MeV levels were observed in the (p,t) reaction. The unnatural parity ($J^\pi = 2^-$) state at 8.88 MeV was the weakest (p,t) transition observed. In the (p,d) reaction deuteron groups corresponding to the ground state of ^{17}O and excited states at 0.871, 3.058 and 3.846 MeV were seen. DWBA analyses of the ground state (p,t) reaction and the first three (p,d) transitions were performed. There was no evidence of a simple pick-up reaction leading to the 3.846 MeV state ($J^\pi = \frac{5}{2}^-$) of ^{17}O. (auth)

40388 POLARIZATION AND PHASE SHIFTS IN ^{12}C(p,p)^{12}C AND ^{16}O(p,p)^{16}O FROM 1.5 TO 3 MeV. Trachslin, Walter (Univ. of Basel); Brown, Louis. Nucl. Phys., A101: 273-87(1967).

Extensive measurements of polarization with a proton beam from a polarized-ion source are reported. The results are analyzed to determine the phase shifts that best reproduce these polarization data and previously reported cross sections for proton energies of 3 MeV and below. Systematic searches for other sets of phases yield many that satisfy cross-section data alone and a few that satisfy polarization data alone. Only one set satisfies both cross-section and polarization data. Interpolated values of the new phase shifts are used to calculate cross sections and polarizations for comparison with measurements in the literature that are not used directly in the analysis and to draw polarization contour maps. An unsuccessful attempt to observe the spin dependence in Coulomb scattering is discussed. (auth)

40389 ELASTIC SCATTERING OF ^{11}B ON ^{11}B. Guenther, G. (Univ., Heidelberg); Bethge, K.; Schubert, K. R. Nucl. Phys., A101: 288-304(1967).

At the Heidelberg tandem Van de Graaff accelerator, differential cross sections of the reaction ^{11}B(^{11}B,^{11}B)^{11}B were measured in the energy range from 2.7 to 15.5 MeV (cm). The production of negative boron ions, the preparation of self-supporting boron targets, and the coincidence detection method are described. The excitation function at 90° cms does not show any resonances or fluctuations in agreement with the statistical theory. All experimental data can be interpreted with the strong absorption mechanism; results of calculations with the smooth cut-off model and the optical model are presented. (auth)

40390 EXCITED STATES IN ^{10}B FROM THE REACTION ^{6}Li(α,α)^{6}Li. Meyer, V.; Pixley, R. E.; Truol, P. (Univ., Zurich). Nucl. Phys., A101: 321-32(1967).

The scattering process ^{6}Li(α,α)^{6}Li was studied in the energy range between 2 and 3.7 MeV. Angular distributions as well as excitation functions, especially in the neighborhood of known but unassigned states, were measured. The shape of the angular distributions does not vary appreciably with energy. The strong backward peak indicates an exchange process between the incoming α-particle and the α-cluster in ^{6}Li. The analysis of the resonance structure of the excitation functions near 2.61, 2.78, and 3.50 MeV leads to the assignments $J^\pi = 4^+$, $J^\pi = 3^-$, and $J^\pi = (2^-, 4^-)$ for the corresponding levels in ^{10}B at 6.02, 6.13, and 6.56 MeV, respectively. The α widths of these levels were found to be Γ_{lab} = 0.09 ± 0.04, 3.93 ± 0.55, and 41.8 ± 1.9 keV, respectively. (auth)

40391 INTERACTIONS OF ^{3}He PARTICLES WITH B, N, Na, AND Be. Hahn, R. L.; Ricci, E. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Nucl. Phys., A101: 353-68 (1967). (ORNL-P-2746).

Thick-target yields for reactions of ^{3}He particles with B, N, Be, and Na were determined by irradiating boron, beryllium nitride, and sodium iodide with ^{3}He ions of energies from 6 to 18 MeV. Excitation functions for the reactions ^{11}B(^{3}He,n)^{13}N, ^{10}B(^{3}He,d)^{11}C, ^{14}N(^{3}He,α)^{13}N, ^{14}N(^{3}He,d)^{15}O, ^{9}Be(^{3}He,n)^{11}C, and ^{23}Na(^{3}He,2p)^{24}Na were obtained by numerical differentiation of the smoothed yield versus energy curves. The distorted-wave theory of nuclear reactions was used to compute excitation functions for comparison with the data for the ^{14}N(^{3}He,α)^{13}N reaction and for the (^{3}He,d) reactions on ^{14}N and ^{10}B. Optical-model potentials, not for the particular nuclides observed, but determined for neighboring light nuclei, were used in the calculations. The results of this comparison of theory with experiment indicate that the ^{14}N(^{3}He,α) and ^{10}B(^{3}He,d) reactions appear to proceed mainly by direct pickup and stripping processes, respectively. For the ^{14}N(^{3}He,d) reaction, a stripping calculation that considered only those ^{15}O states with known spins and parities yielded a lower limit of ≈30% of the observed excitation function. (auth)

40392 SCATTERING AND PICK-UP REACTIONS WITH DEUTERONS ON Be, B, C, N, AND O AT 11.8 MeV. Fitz, W.; Jahr, R.; Santo, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys., A101: 449-59(1967).

The elastic deuteron scattering data from Be, ^{10}B, ^{11}B, C, N, and O were analyzed in terms of the optical model. It was possible to obtain optical parameters which show only small variations from one nucleus to the other. Experimental angular distributions of deuterons from the (d,d′) reactions on ^{9}Be, ^{10}B and ^{12}C, of tritons from the (d,t) reactions on ^{9}Be, ^{10}B, and ^{11}B and of ^{3}He particles from the (d,^{3}He) reactions on ^{10}B and ^{11}B were analyzed in terms of the DWBA theory. Satisfactory fits to the pickup data were obtained using the deuteron potentials derived from the elastic scattering. Spectroscopic factors were extracted and are compared with intermediate coupling calculations. (auth)

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Refer also to abstracts 39183, 40143, 40144, 40391, 40421, 40429,

40430, 40432, 40447, 40463, 40473, 40474, 40477, 40478, and 40506.

40393 (BNL-11643) MAGNETIC MOMENT OF THE $d_{\frac{3}{2}}$ HOLE STATE IN ^{47}Sc. Fossan, D. B. (State Univ. of New York, Stony Brook. Brookhaven National Lab., Upton, N. Y.); Poletti, A. R. (Brookhaven National Lab., Upton, N. Y.). [1966]. 14p. (CONF-670812-4). Dep. CFSTI.

From International Conference on Hyperfine Interactions, Pacific Grove, Calif.

The magnetic moment of the 760-keV level in ^{47}Sc was measured, using the ^{44}Ca(α,p)^{47}Sc reaction and the differential time-delay technique, to be $\mu = (0.35 \pm 0.05)\mu_N$. A half-life of 269 ± 12 nsec was also obtained from the results for this level. This magnetic moment result is consistent with an interpretation for this level of no core-excitation admixtures in the $d_{\frac{3}{2}}$ hole wave function. (auth)

40394 (CAR-882-22) MUON CAPTURE NEUTRONS, ASYMMETRY, AND SPECTRUM. Sundelin, Ronald M. (Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Physics). June 1967. Contract AT(30-1)-882. 126p. Dep. CFSTI.

Thesis.

The asymmetry in the angular distribution of neutrons emitted following the capture of negative muons in Si, S, and Ca was measured. The measurement was made by stopping polarized muons in a magnetic field, in which the muons precessed, and recording the number of neutrons detected in a fixed counter as a function of the time after a muon stop. The events were simultaneously sorted according to the pulse height observed in the counter. Neutrons were distinguished from gamma rays by pulse shape discrimination. The asymmetries for the three elements, normalized to complete muon polarization, varied from near zero for small pulse heights to +0.32 ± 0.05, +0.30 ± 0.08, and +0.20 ± 0.08 for pulse heights greater than that produced by a 15.6-MeV proton, for Si, S, and Ca respectively. These numbers disagree both in magnitude and in sign with the results of other recent measurements. The neutron energy spectra were obtained from the neutron pulse height spectra by an unfolding process. In the energy range studied, 7.7 to 52.5 MeV, the neutron energy spectra decreased exponentially with increasing energy. The spectral integrals between these energy limits were 0.23 ± 0.04, 0.21 ± 0.04, and 0.18 ± 0.03 neutrons per capture, and the exponential decay constants were 7.6, 7.3, and 7.2 MeV, for Si, S, and Ca, respectively. (auth)

40395 (NASA-TN-D-4140) DIFFERENTIAL CROSS SECTIONS FOR (d,α) REACTION ON ^{45}Sc. Priest, Joseph R.; Vincent, John S. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Sept. 1967. 11p. CFSTI.

The differential cross sections corresponding to the production of the ground and first five excited states of calcium 43 in the ^{45}Sc(d,α)^{43}Ca reaction were measured for a deuteron energy of 20.9 MeV (33.5×10^{-13} J). The angular distribution for the ground-state transition extends from 15 to 170°; the remaining angular distributions range from 15 to 100°. The differential cross sections for the ground-state transitions are, in general, more than 10 times larger than those for the transitions to excited states; this is interpreted to be a consequence of the large overlap of the ground-state configurations of scandium 45 and calcium 43. The differential cross sections for production of two core-excited states of ^{43}Ca are small (1 to 10 μb/sr; 10^{-34} to 10^{-33} m^2/sr) but not negligible and are comparable to those of the other excited states investigated. The interpretation of the reaction mechanism for these transitions poses an interesting theoretical problem. (auth)

40396 (NP-16840) ETUDE DE LA CORRELATION $\beta-\gamma$ POLARISE CIRCULAIREMENT DANS LA TRANSITION $2^-(\beta)2^+(\gamma)0^+$ DU RUBIDIUM 86. (Study of the Circularly Polarized $\beta-\gamma$ Correlation in the $2^-(\beta)2^+(\gamma)0^+$ Transition of ^{86}Rb). Renard, Jean-Claude (Grenoble Univ. (France). Laboratoire de Physique Nucleaire). [1964]. 87p. (In French). DTIE.

Thesis.

The degree of circular polarization of photons in the $2^-(\beta)2^+(\gamma)0^+$ transition of ^{86}Rb was measured. By measurement of the circular polarization for different values of the angle, the coefficients A_N of the correlation function were determined. The experimental apparatus is described in detail, and the measurement of the angular distribution is outlined. The circular polarization of the protons was then measured. As the value for the coefficient a_3 is sharply different from zero, the transition can not be interpreted within the framework of the ξ approximation. This conclusion is in agreement with results of directional correlation measurements. It was shown that the contribution of the matrix element $m(B_{ij})$ is relatively important but that the modified B_{ij} approximation can not be applied. (J.S.R.)

40397 (NYO-2897-22) NUCLEAR CHEMISTRY RESEARCH OF HIGH ENERGY NUCLEAR REACTIONS AT CARNEGIE INSTITUTE OF TECHNOLOGY. Annual Progress Report, 1966–1967. (Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Chemistry). June 1, 1967. Contract AT(30-1)-2897. 70p. Dep. CFSTI.

MAGNESIUM-25 — proton reactions (p,2p) at 300 MeV, recoil studies of; proton reactions (p,2p) and (p,2p2n) at 100 to 400 MeV, cross sections for,
MAGNESIUM-26 — proton reactions (p,2pn) and (p,2p3n) at 100 to 400 MeV, cross sections for,
ALUMINUM-27 — proton reactions (p,3p3n) at 100 to 400 MeV, cross sections for,
CADMIUM ISOTOPES — proton reactions (p,xn), (p,pxn), and (p,2pxn) at 400 MeV, cross sections for,
ANTIMONY-129, -127, -125, -122, IODINE-122 — beta decay half-life,
ANTIMONY-124, TELLURIUM-129, -127 — beta decay half-life of isomeric,
TELLURIUM-121, IODINE-125 — electron-capture decay half-life,
TELLURIUM-125, -123, -121 — electromagnetic decay half-life of isomeric,
IODINE-124, -121 — beta and electron-capture decay half-life,
COPPER-65 — proton reactions (p,pn) with, recoil studies of,
PROTONS — reactions (p,n) and (p,2n) on copper-63 and iron-56 at 100 to 400 MeV, cross sections for,
TETRANEUTRONS — experimental apparatus for observing
COMPUTER PROGRAMS — review, for nuclear reaction studies (S.F.L.)

40398 (RISO-157) CIRCULAR POLARIZATION OF CAPTURE GAMMA RAYS FROM ^{35}Cl(n,γ)^{36}Cl MEASURED WITH A Ge(Li) DETECTOR. Kopecky, J.; Ratynski, W.; Warming, E. (Danish Atomic Energy Commission, Risoe. Research Establishment). June 1967. 8p. Dep.

Spin assignments were obtained for the levels at 0.79 MeV (3^+) and 1.60 MeV(1^+) in the ^{36}Cl nucleus by measuring the circular polarization of capture γ rays. For the 2.87 MeV level, 3^- is indicated although 4^- can not be entirely excluded. (auth) (Denmark)

40399 (RPI-328-87) LINEAR ACCELERATOR PROJECT. Progress Report, January–March 1967. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. 90p. Dep. CFSTI.

Separate abstracts were written for the four major sections of this report, involving neutron cross sections, fast neutron spectra, neutron thermalization, and low energy inelastic scattering. (S.F.L.)

For abstracts of individual sections see: 40346–40348 and 40430.

40400 (ZfK-PhA-24) DER VERGLEICH VON (d,p)- UND (n,γ)-REAKTIONEN AN DEN UU-KERNEN K^{40}, Sc^{46}, V^{52} UND Co^{60}. (Comparison of (d,p) and (n,γ) Reactions on the Odd-Odd Nuclei ^{40}K, ^{46}Sc, ^{52}V, and ^{60}Co). Rudolph, Werner (Zentralstelle fuer Kernforschung, Rossendorf Bei Dresden (East Germany)). Jan. 1967. 78p. (In German). Dep.

The high-energy γ radiation which is emitted after the capture of thermal neutrons by the odd-odd nuclei ^{40}K, ^{46}Sc, ^{52}V, and ^{60}Co was measured. The experimentally reduced intensities I_γ/E_γ^5 of the primary γ transition were compared with the probabilities for the population of the same levels in the (d,p) reaction. This comparison shows that in the (n,γ) reaction many levels with large constituents of a single-particle excitation of the neutron group were very strongly populated by primary γ transitions. However, very intensive primary γ transitions were observed to the states which in the (d,p) reaction were only very weakly excited and which therefore can contain only slight fractions of the configuration "target ground state + single neutron". The experimental transition probabilities were interpreted in the framework of a model in which the γ transitions were described as single-particle transition and core excitation was considered. A study was made to determine which correlations in the direct capture of neutrons are to be expected in the (n,γ) reaction. In the framework of the model used it was shown that in this case a rigid correlation of the (relative) transition probabilities in both reactions should be ascribed to neutron p-states. A detailed comparison of the experimental transition probabilities shows that this type of correlation is not present. (tr-auth)

40401 THE PRODUCTION OF RADIOISOTOPE ^{28}Mg. Mori, M.; Chiba, R.; Tani, A.; Aikawa, H.; Kawai, N. (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Japan). Int. J. Appl. Radiat. Isotop., 18: 579-83(Aug. 1967).

Magnesium-28, with a 21-hr half-life, was produced in a specific activity of 100 mc/g by a ^{26}Mg(t,p)^{28}Mg reaction, using tritons ac-

celerated by an electrostatic accelerator. Magnesium oxide enriched to 99.6% in magnesium-26 was used as a target. About 250 μ curies of magnesium-28 were obtained in 2 hr irradiation. The total cross section of the $^{26}Mg(t,p)^{28}Mg$ reaction was measured as a function of the triton energy up to 3.5 MeV. (auth) (UK)

40402 FINE STRUCTURE OF THE CROSS SECTION OF THE $^{40}Ca(\gamma,n)$ REACTION. Goryachev, B. I.; Ishkhanov, B. S.; Shevchenko, V. G.; Yur'ev, B. A. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz., 5: 1138-9(May 1967). (In Russian).

Following up recent studies on the cross section of (γ,n) and (γ,p) reactions on magic nuclei, the (γ,n) reaction ^{40}Ca was studied on the 35-MeV betatron. The neutrons were recorded directly with a device consisting of a paraffin sphere containing 80 proportional BF_3 counters; the drift was suppressed by using a multichannel system. The measurements were carried out within the 15.5 to 30.0-MeV range, with an error of 0.1%. The cross-section curve was found to possess 10 sharp maxima at 16.1 ± 0.1, 18.5 ± 0.1, 19.1 ± 0.1, 19.6 ± 0.1, 20.0 ± 0.1, 21.0 ± 0.1, 22.0 ± 0.2, 23.2 ± 0.2, 25.5 ± 0.3, and 27.9 ± 0.3 MeV. The shape of the curve up to 20 MeV agrees with data reported by I. E. E. Baglin and B. M. Spicer. The 25.5- and 27.9-MeV maxima are of special interest because they could indicate the presence of additives with a higher configuration to the ground state of the ^{40}Ca nucleus, enriching the cross-section spectrum in the high-energy and giant resonance range. (TTT)

40403 EXCITATION FUNCTIONS FOR THE REACTIONS $^{60}Ni(n,p)^{60}Co$ AND $^{63}Cu(n,\alpha)^{60}Co$. Paulsen, A. (EURATOM, Geel, Belg.). Nukleonik, 10: 91–2(July 1967). (In German).

The cross sections for the reactions $^{60}Ni(n,p)^{60}Co$ and $^{63}Cu(n,\alpha)^{60}Co$ were determined in the regions of 8.5 to 12 MeV and 16.5 to 19.5 MeV to supplement earlier measurements, so that the excitation functions are known with about ± 6 to 12% uncertainty from 6 to 20 MeV. The mean cross sections in the fission spectrum was calculated to be $\bar{\sigma}$ = 2.3 ± 0.3 and 0.34 ± 0.04, respectively. (tr-auth)

40404 L/K-CAPTURE RATIO OF ^{65}Zn. Totzek, D.; Hoffmann, K.-W. (Technische Hochschule, Stuttgart). Z. Phys., 205: 137–44(1967). (In German).

A multiwire proportional counter was constructed to measure L/K-capture ratios. The length of the counter is 90 cm with a diameter of 14 cm, and it works with pressures from 1 to 6 atm. The counter was proved by measuring the L/K capture ratio of ^{37}Ar. The result obtained is 0.098 ± 0.003, in agreement with the calculated ratio 0.100 of Bahcall and the results of many other measurements with multiwire proportional counters. Gaseous zinc diethyl was the substance used to determine the L/K capture ratio of ^{65}Zn. The result obtained is 0.111 ± 0.006, in agreement with the calculated ratio 0.109 of Bahcall, while 0.119 ± 0.007 measured with a multiwire proportional counter by Santos Ocampo and Conway is somewhat above the calculated ratio. (auth)

40405 CROSS SECTIONS OF THE REACTIONS $^{76}Se(n,p)$, $^{77}Se(n,d)$, $^{77}Se(n,np)$, AND $^{80}Se(n,\alpha)$ WITH 14.7-MeV NEUTRONS. Ivanenko, V. V.; Petrzhak, K. A.; Potamanov, V. I. Yadern. Fiz., 6: 11–12(July 1967). (In Russian).

An activation method was used to measure the cross sections of the reactions $^{76}Se(n,p)$ and $^{80}Se(n,\alpha)$ and the sum of the $^{77}Se(n,d)$ and $^{77}Se(n,np)$ reaction cross sections on the enriched Se isotopes. The following values were obtained: $\sigma_{(n,p)}$ = 68 ± 8 mb; $\sigma_{(n,\alpha)}$ = 146 ± 22 mb; $\sigma_{(n,d)+(n,np)}$ = 12.1 ± 1.6 mb. The (n, p) reaction cross section differs strongly from that predicted by Gardner ($\sigma \sim 152$ mb). The (n, α) cross section value for $^{82}_{34}Se_{48}$ confirms the conclusion on the sharp increase of the (n, α) cross sections in the closed-neutron shell region. (auth)

40406 SPIN OF THE ^{52}V GROUND STATE. Sergeev, A. G.; Vesna, V. A.; Kalinichev, Yu. V. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 6: 6–10(July 1967). (In Russian).

The γ spectrum from the $^{52}V \xrightarrow{\beta} {}^{52}Cr$ decay was studied with the magnetic Compton spectrometer. Weak γ transitions were found that indicate the direct β-decay excitation of the ^{52}Cr levels: 4^+ at 2.765 MeV and 2^+ at 2.966 MeV. It is concluded that the ^{52}V ground state has $J^\pi = 3^+$. The comparison with the theory of the residual np interaction is carried out. (auth)

40407 ELASTIC SCATTERING OF PROTONS AT THE THRESHOLD FOR THE QUASI-ELASTIC (p,n) PROCESS. Bondorf, J. P.; Ellegaard, C.; Kantele, J.; Lutken, H.; Vedelsby, P. (Univ. of Copenhagen). Nucl. Phys., A101: 338–52(1967).

The excitation functions for elastic scattering of protons from ^{48}Ca and ^{91}Zr were measured at several observation angles for proton energies in the vicinity of the threshold for the quasi-elastic (p,n) scattering process. For ^{91}Zr, the excitation function for the quasi-elastic (p,n) reaction was measured by observing the decay protons from the analogue state. A theoretical investigation of the threshold effects in the framework of the coupled-channel Lane model is carried out, and the calculated cross sections are compared to the measured values. The present results suggest that the expected energy dependence of the proton wave function due to the isovector coupling in the nucleon channel does not explain the threshold anomalies observed previously in the $^{90}Zr(d,p)$ reaction. (auth)

40408 THE REACTIONS $^{27}Al(n,p)^{27}Mg$ AND $^{28}Si(n,p)^{28}Al$ AT NEUTRON ENERGIES AROUND 8 MeV. Debertin, K.; Guenther, H.; Roessle, E. (Johann-Wolfgang-Goethe Univ., Frankfurt am Main). Nucl. Phys., A101: 473–80(1967).

Angular distributions of proton groups from the reactions $^{27}Al(n,p)^{27}Mg$ and $^{28}Si(n,p)^{28}Al$ leading to well specified states in the residual nuclei were measured at neutron energies between 7.7 and 9.1 MeV with a scintillation counter telescope. The distributions show, if any, only slight departures from symmetry to 90°. (auth)

40409 COMPILATION OF ELECTROMAGNETIC TRANSITION RATES IN LIGHT NUCLEI (A ≤ 40). Skorka, S. J.; Hertel, J.; Retz-Schmidt, T. W. (Univ., Hamburg). Nucl. Data, Sect. A, 2: 347–401(Nov. 1966).

Data on absolute electromagnetic transition rates in nuclei of the 1p- and 2s1d-shells are presented. The experimental results for partial widths with quoted errors, transition strengths, and reduced transition probabilities are listed. Averages and mean errors of the averages in cases where more than one experimental result on a certain transition is available are also given. Additional information, mainly mixing ratios which were used to calculate transition strengths in mixed transitions, as well as widths or lifetimes which could not be further reduced are contained in a separate table. Branching ratios are not listed. A survey of mean transition strengths and of standard deviations from the mean values for the various multipole types of transitions, subdivided according to the isospin selection rules are given. The distributions of the transition strengths are presented in a number of histograms. The dependence of the transition strengths on the mass number and excitation energy, as well as T-forbiddenness factors, are discussed and in some cases graphically illustrated. (auth)

40410 NEUTRON-PICKUP REACTIONS ON ^{26}Mg. Dehnhard, D.; Yntema, J. L. (Argonne National Lab., Ill.). Phys. Rev., 160: 964-72(Aug. 20, 1967).

The single-neutron pickup from ^{26}Mg was studied with both the (d,t) and the ($^3He,\alpha$) reaction. Absolute and differential cross sections were measured at forward angles with the 21.5-MeV deuteron beam and the 33.0-MeV ^3He beam of the Argonne 60 in. cyclotron. Spectroscopic factors from the two different reactions were generally found to be in very good agreement for the transitions to the low excited states. The experimental results are compared with predictions of the Nilsson model. It is found that band mixing due to the Coriolis force can explain the rather large absolute strength of the ground-state transition and the absence of strong transitions to two rotational bands based on Nilsson orbits No. 6 and 7. (auth)

40411 INELASTIC SCATTERING IN THE 2s-1d SHELL. I. EVEN-A NUCLEI. Crawley, G. M.; Garvey, G. T. (Princeton Univ., N. J.). Phys. Rev., 160: 981–97(Aug. 20, 1967). (PUC–937–240).

The inelastic scattering of 17.5-MeV protons from a number of nuclei in the 2s-1d shell was studied using Li-drifted Si detectors. Results for the even-A nuclei ^{16}O, ^{24}Mg, ^{26}Mg, ^{28}Si, and ^{32}S are presented. Angular distributions are obtained for up to twenty levels in each nucleus. While some of the angular distributions having the same l value are similar, there were a number of cases where angular distributions to states in the same nucleus with the same spin and parity have very different angular distributions. The differential cross sections for the most strongly excited levels are compared with a distorted-wave Born-approximation calculation using collective form factors. Reasonable fits to the differential cross sections were obtained for the l = 2 transitions to the first excited states of ^{24}Mg, ^{28}Si, and ^{32}S and for the l = 3 transitions to the lowest-lying 3^- states of ^{16}O, ^{24}Mg, ^{28}Si, and ^{32}S. A previously unreported level in ^{32}S at 6.76 MeV was observed. (auth)

40412 WIDTH-FLUCTUATION EFFECTS IN $(n,n'\gamma)$ REACTIONS. Mathur, Suresh C.; Buchanan, P. S.; Morgan, I. L. (Texas Nuclear Corp., Austin). Contract AT(40-1)-2791. Phys. Rev., 160: 816–27(Aug. 20, 1967). (ORO–2791–23).

The effects of level-width fluctuations in $(n,n'\gamma)$ reactions were studied for several nuclei. Moldauer has developed a formulation for describing width-fluctuation effects in neutron inelastic scattering. Gamma ray angular distributions and cross sections in $(n,n'\gamma)$ reactions with ^{24}Mg, ^{27}Al, ^{28}Si, ^{40}Ar, ^{56}Fe, and ^{208}Pb were

calculated on the basis of Satchler's theory, with the inclusion of width-fluctuation corrections based on Moldauer's formulation. It is found that in the region of threshold or in the cases where only a single level is excited, the inclusion of width-fluctuation effects reduces the cross sections by as much as 45%. The reduction in cross sections is smaller in the cases where several levels are excited. However, in all cases, the agreement between the experimental and calculated cross sections is significantly improved with the inclusion of width-fluctuation corrections. The shape and anisotropy of the γ distributions are not significantly altered by the width-fluctuation corrections. (auth)

40413 NEUTRON PICKUP FROM ^{46}Ca. Bjerregaard, J. H. (Univ. of Copenhagen); Hansen, Ole; Satchler, G. R. Phys. Rev., 160: 889-93(Aug. 20, 1967).

The reaction ^{46}Ca(d,t)^{45}Ca was investigated at 10-MeV bombarding energy with 11-keV energy resolution. States in ^{45}Ca at 0 keV ($^7/_2^-$), 176 keV ($^5/_2$), and 1886 keV ($^3/_2^+$) were excited with spectroscopic factors of 6.5 ± 1.5, <0.25, and 1.3 ± 0.4, respectively. The application of the distorted-wave Born approximation to the (d,t) reaction is discussed in some detail. The data are computed with results from neutron transfer reactions on ^{46}Ca and neighboring nuclei. (auth)

40414 STUDY OF LOW-LYING STATES IN ^{46}Ti, ^{48}Ti, AND ^{54}Fe. Church, D. J.; Horoshko, R. N.; Mitchell, G. E. (Columbia Univ., N. Y.). Phys. Rev., 160: 894-902(Aug. 20, 1967).

Several excited states in the nuclei ^{46}Ti, ^{48}Ti, and ^{54}Fe were studied by means of triple angular-correlation measurements. The excited states were produced by proton inelastic scattering, and γ-γ angular correlations were measured on the cascade from the state being studied, through the first excited state. The 2.01-, 2.61-, and 2.96-MeV states in ^{46}Ti were studied at a proton bombarding energy of 5.00 MeV. The experimental results for the 2.01-MeV state were consistent with a previous J = 4 assignment. The results yielded a J = 0 assignment to the 2.61-MeV state. The results for the 2.96-MeV state indicate either J = 2 or J = 3, with J = 2 strongly favored. The mixing ratio for the transition from the 2.96-MeV state to the 0.89-MeV state is $\delta = (-1.07 \pm 0.15)$ for J = 2, or $\delta = (+0.26 \pm 0.05)$ for J = 3. The 3.00-MeV state in ^{48}Ti was studied at a bombarding energy of 4.75-MeV. The experimental results yielded a J = 0 assignment to the 3.00-MeV state. The 2.56-MeV state in ^{54}Fe was studied at a bombarding energy of 5.15 MeV. The results yielded a spin assignment of J = 0 to the 2.56-MeV state. (auth)

40415 ^{52}Cr(p,d)^{51}Cr AND ^{50}Cr(p,d)^{49}Cr REACTIONS AT 17.5 MeV. Whitten, C. A. Jr.; McIntyre, L. C. (Princeton Univ., N. J.). Phys. Rev., 160: 997-1004(Aug. 20, 1967).

The ^{52}Cr(p,d)^{51}Cr and ^{50}Cr(p,d)^{49}Cr reactions were studied with 17.5-MeV protons from the Princeton FM cyclotron. Thin (~0.5 mg/cm^2), isotopic, essentially self-supported chromium foils were used, and the deuterons were identified by a dE/dx-E solid-state detector telescope. The total experimental resolution was between 55 and 70 keV. Angular distributions for many (p,d) transitions were obtained from 15 to 150°. Spectroscopic factors for the strong (p,d) transitions were obtained with the use of a distorted-wave Born-approximation (DWBA) computer program which included both finite-range and nonlocal effects in the reaction mechanism. In the ^{52}Cr(p,d)^{51}Cr reaction, strong $l_n = 3$ transitions were observed to the ^{51}Cr ground state and the 2.339-MeV level, while a level at 2.79 ± 0.01 MeV was excited with an $l_n = 0$ angular distribution. The 0.766-MeV $^3/_2^-$ −0.803-MeV ($^1/_2^-$) doublet and the 1.927-MeV $^3/_2^-$ level in ^{51}Cr were also excited. In the ^{50}Cr(p,d)^{49}Cr reaction the $^5/_2^-$ ground state was weakly excited, while a strong $l_n = 3$ (p,d) transition was observed to the $^7/_2^-$ level at 0.27 MeV. Additional weakly excited levels in ^{49}Cr were observed at excitation energies of 1.08, 1.57, 1.76, 1.97, and 2.63 MeV. The ^{50}Cr(p,d)^{49}Cr ground-state Q value was measured to be −10.79 ± 0.03 MeV. (auth)

40416 NUCLEAR STRUCTURE OF ^{22}Na. I. GAMMA-RAY CORRELATIONS AND LIFETIME MEASUREMENTS FOR LEVELS OF $E_{ex} < 3.1$ MeV. Warburton, E. K.; Olness, J. W.; Poletti, A. R. (Brookhaven National Lab., Upton). Phys. Rev., 160: 938-63(Aug. 20, 1967).

Levels of ^{22}Na below an excitation energy of 3.1 MeV were investigated through the ^{19}F(α,nγ)^{22}Na and ^{20}Ne(^{3}He,pγ)^{22}Na reactions. Gamma-ray spectra from the first reaction were recorded with an 8-cc Ge(Li) detector at 90, 0, and 166° to the α beam using CaF_2 targets and α energies between 4.0 and 7.0 MeV. Spectra were similarly recorded at 90° for $E_{^3He}$ = 5.65 MeV in the second reaction. These studies were supplemented by γ-γ coincidence measurements with both NaI(Tl)-NaI(Tl) and NaI(Tl)-Ge(Li) γ-ray detector combinations. Gamma-ray angular distributions were measured at E_α = 5.48 MeV using the ^{19}F(α,n)^{22}Na reaction and p-γ angular correlations were measured at $E_{^3He}$ = 5.65 MeV using the ^{20}Ne(^{3}He,p)^{22}Na reaction. From these measurements excitation energies and γ-ray decay modes were determined for the levels below 3.1-MeV excitation, information on spin-parity and isotopic-spin assignments was obtained, and values or limits for the mean lifetimes of the levels were extracted from observations of the γ-ray Doppler shifts. An isotopic-spin assignment of T = 1 was made to the ^{22}Na 1.952-MeV level; all other levels in the range $0.7 < E_x(\text{MeV}) < 3.1$ were assigned T = 0. Upon combining results with previously available information, the following spin-parity and lifetime information was deduced: $\{E_{ex}(\text{MeV})\ [J^\pi;\ \tau_m(\text{psec})]\}$ for the third through eleventh levels of ^{22}Na: 0.891 (4^+; >8), 1.528 (3^+, 5^+; 3.8 ± 0.9), 1.937 (1^+; <0.06), 1.952 (1, 2; <0.09), 1.984 (2^+, 3^+; 1.6 ± 0.34), 2.211 (1; >11), 2.572 (≤3; >10), 2.969 (≤3; <0.14), 3.059 (≤3; <0.09). The combined influence of Doppler effects and the lifetimes of the initial states on the shapes of the full-energy-loss peaks of the 1.528 → 0 and 1.984 → 0.583 transitions is quite marked. The analysis of these shapes to obtain the lifetimes given above is described in detail. Some incidental information concerning excitation energies and lifetimes of energy levels in ^{19}F and ^{22}Ne is given in an Appendix. (auth)

40417 STUDY OF LEVELS IN ^{23}Mg. Dubois, J.; Earwaker, L. G. (California Inst. of Tech., Pasadena). Phys. Rev., 160: 925-37(Aug. 20, 1967).

Levels in ^{23}Mg with excitation energies up to 6.8 MeV were investigated by magnetic analysis of the α particles from the reaction ^{24}Mg(^{3}He,α)^{23}Mg at bombarding energies between 6 and 12 MeV. Between 4.4- and 6.8-MeV excitation energy, 16 new levels were found in ^{23}Mg. Angular distributions of the emitted α particles were measured and from distorted-wave Born-approximation analysis l values for the picked up neutrons were obtained. The particle-γ angular-correlation method of Litherland and Ferguson was used to obtain additional information on the spin assignments of the levels as well as branching and mixing ratios of the γ-ray transitions. The following spin and parity assignments have been established for the indicated levels: 0.451 MeV $^5/_2^+$, 2.048 MeV $^7/_2$ ($^5/_2$), 2.356 MeV $^1/_2^+$, 2.768 MeV ($^1/_2$,$^3/_2$)$^-$, 2.904 MeV ($^3/_2$,$^5/_2$)$^+$, 3.792 MeV $^3/_2^-$, 4.353 MeV $^1/_2^+$, 5.289 MeV ($^3/_2$,$^5/_2$)$^+$, and 5.992 MeV ($^1/_2$,$^3/_2$)$^-$. The experimental results are compared with those obtained for ^{23}Na and the predictions of the collective model. (auth)

40418 RADIOACTIVE DECAY OF ^{83}Se. Marlow, Keith Winton. College Park, Md., Univ. of Maryland, 1966. 236p.

Thesis.

The radioactive decay of ^{83}Se was investigated experimentally, leading to a proposed level scheme for ^{83}Br. The radioactive ^{83}Se nuclei were produced by means of the (n,γ) reaction resulting from reactor-neutron bombardment of selenium samples enriched to 90% in ^{82}Se. The γ radiation was studied using Li-drifted Ge detectors and NaI(Tl) detectors, while the β radiation was studied using Li-drifted Si detectors. Coincidence relations have been observed using the techniques of β-γ, γ-γ, delayed-coincidence, and the sum-coincidence spectroscopy. Gamma-gamma directional correlation measurements were performed on selected γ-ray cascades using a four-detector apparatus. The half-life of the long-lived decay was determined to be 22.6 ± 0.2 min and the 70-sec half-life of ^{83m}Se was confirmed. For the long-lived decay, the various coincidence studies lead to a proposed decay scheme incorporating 29 γ-rays and involving excited levels in ^{83}Br at 356, 801, 868, 1094, 1355, 1421, 1438, 1814, 2060, 2650, 2697, 2738, and 2777 keV. From the levels at 2650 and 2697 keV originate five-member cascades involving successive transitions to the 1814-, 1094-, 868-, 356-, and 0-keV levels. The 1094-keV level was found to decay with $T_{\frac{1}{2}}$ = 4.1 ± 0.1 nanosec. Although coincidence measurements have not been made in the study of the short-lived isomer, β- and γ-ray spectrum measurements lead to the placement of nine γ-rays in the proposed decay scheme, with excited levels at 356, 1032, 1063, 2022, 2054, and 2147 keV. Log(ft) values, determined from the studies of β-ray spectra, were used to limit spin and parity assignments for many of the levels, while lifetime and directional correlation measurements provided further limitations on the assignments for a few levels. The proposed level scheme of ^{83}Br was compared with the predictions of various forms of the core-excitation model of the nucleus. In particular, the model of Bayman and Silverberg with an intermediate coupling strength predicts a level scheme which is strikingly similar to the one observed for ^{83}Br. In terms of their model, the delayed level at 1049 keV was interpreted as resulting from the hindrance of transitions between different rotational bands in a deformed nucleus. (Disser. Abstr.)

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Refer also to abstracts 39183, 39258, 40143, 40144, 40148, 40374,

40397, 40399, 40407, 40467, 40468, 40473, 40474, 40477, 40478, and 40675.

40419 (AE-287) ABSOLUTE E1, ΔK = 0 TRANSITION RATES IN ODD-MASS Pm AND Eu-ISOTOPES. Malmskog, Sven G. (Aktiebolaget Atomenergi, Stockholm (Sweden)). June 1967. 33p. Dep. SWED.

The half-life of the $5/2^-$ (532) intrinsic state in ^{151}Pm, ^{153}Eu, and ^{155}Eu was determined by the delayed coincidence method. The absolute E1, ΔK = 0 transition probabilities between the $5/2^-$ (532) → $5/2^+$ (413) intrinsic states were deduced and were compared with theoretical predictions, using the Nilsson model as a starting point. The effect on the predicted transition probabilities obtained by adding pairing correlations and Coriolis coupling was also studied. It was found that the experimental transition rates, which are still strongly enhanced, can not be explained by these contributions alone. It is therefore suggested that collective dipole contributions like those arising through the octupole excitations are of importance. (auth)

40420 (AEEW-R-526) MEASUREMENTS AND CALCULATIONS OF RATIOS OF EFFECTIVE FISSION CROSS SECTIONS IN THE ZERO-POWER FAST REACTOR, ZEBRA. Stevenson, J. M.; Broomfield, A. M. (Atomic Energy Establishment, Winfrith (England)). June 1967. 22p. Dep. CFSTI. UK 4s. 0d.

The comparison of measured and calculated central fission ratios provides a useful method for checking the accuracy of calculated spectra and fission cross-section data. A set of parallel plate fission chambers was specially made for Zebra. The design was based on that of Kirn's chambers used by the ZPR-III group at ANL, Idaho, and incorporated a number of improvements. In particular, the wall thickness was reduced to reduce the degradation of the spectrum. The fissile coatings in the earlier chambers were prepared by a painting technique and those in the later chambers by an electrodeposition method. The mass deposited was determined by low geometry α-assay. The construction of the chambers and the method of calibration and use are described. Central fission ratios in six Zebra cores measured to an accuracy of 1 to 3% are compared with values computed using the FD2 data set and the CRAM or SCRAMBLE multigroup diffusion theory programs. This comparison suggests that the calculations give too few neutrons at high energies. There is also evidence that some of the fission cross-section data used in the FD2 set is in error. (auth)

40421 (COO-1549-3) NUCLEAR STUDIES USING NUCLEAR EMULSIONS. Technical Progress Report. Eldridge, Hudson B.; Simon, William G. (Wyoming Univ., Laramie). July 31, 1967. Contract AT(11-1)-1549. 24p. Dep. CFSTI.

A beam transport system and a scattering chamber were added to the University of Colorado cyclotron, and methods were developed for processing nuclear emulsions. The angular and energy distributions of neutrons from the reactions of 160-MeV ^{16}O ions with Ni and Ag were measured as were the neutron energy spectra from Pu–Be and Ra–Be sources. A computer program was written to study the effects of variations of parameters on time-of-flight neutron spectrometers, and a neutron spectrometer using NE102 plastic scintillator was built and tested. (D.C.W.)

40422 (INR-791/IA/PL) FUNKCJE WZBUDZENIA I ROZKLADY KATOWE REAKCJI PRZEJSCIA WIELU NUKLEONOW W ODDZIALYWANIU Z CIEZKIMI JONAMI. (Excitation Functions and Angular Distributions of Multinucleon Transfer Reactions in the Interaction Between Complex Nuclei). Tys, Jan (Institute of Nuclear Research, Warsaw (Poland)). 1967. 6p. (In Polish). Dep.

Excitation functions of 3p and 2p2n transfer reactions and p or 2n exchange reactions were measured with C, Al, Cu and Ta targets bombarded with ^{16}O, ^{20}Ne, and ^{22}Ne ions in the energy interval of 5 to 8 MeV/amu. Angular distributions of ^{17}N nuclei in the 3n transfer reactions on Ta and Au and 2n transfer reactions on Ta, Au and ^{90}Zr, ^{92}Zr, ^{94}Zr, bombarded with ^{14}N and ^{15}N ions about 90 MeV and 100 MeV were measured. (auth)

40423 (JINR-P3-3417) RADIATSIONNYI ZAKHVAT NEITRONOV YADRAMI S A = 140–200. (Neutron Radiative Capture by the Nuclei with A = 140–200). Konks, V. A.; Popov, Yu. P.; Fenin, Yu. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1967. 12p. (In Russian). Dep.

The results of a measurement of the energy dependence of radiative capture cross sections for neutrons by Eu, ^{153}Eu, Ho, and Lu nuclei in the energy region up to 500 keV are given. The values of the force functions for s- and p-wave neutrons are obtained as a result of the analysis of the energy dependence of averaged capture cross sections. (auth)

40424 (JINR-P4-3451) ODNOCHASTICHNYE SOSTOYANIYA DEFORMIROVANNYKH YADER REDKOZEMEL'NOI OBLASTI V PRIBLIZHENII KONECHNOGO POTENTSIALA S RAZMYTYM KRAEM. (One-Particle States of Deformed Nuclei of the Rare-Earth Region in the Approximation of a Final Potential Having a Diffused Edge). Gareev, F. A.; Ivanova, S. P.; Kalinkin, B. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 30p. (In Russian). Dep.

An analysis is carried out of one-particle states of deformed axially symmetrical nuclei in the approximation of a final potential having a diffused edge. The schemes of the rare-earth levels, which agree with experiment, are calculated. The consequences of the solution of the problem are discussed. They prove that the use of the states obtained can promote more detailed investigation of the properties of deformed nuclei. (auth)

40425 (JINR-P6-3343) O RASPADE ^{166}Tm. (On the Decay of ^{166}Tm). Abdumalikov, A.; Adam, I.; Vrzal, Ya.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 34p. (In Russian). Dep.

Investigations of the ^{166}Tm decay are summarized. Conversion-electron spectra, γ rays, γ–γ and e–γ coincidences were studied. A great number of new γ transitions was found. The multipolarities of a series of γ transitions were determined. The decay scheme constructed was analyzed on the basis of modern nuclear models. (auth)

40426 (JINR-P7-3262) IZOMERNOE OTNOSHENIE DLYA SPONTANNO DELYASHCHEGOSYA IZOMERA ^{242f}Am. (Isomeric Cross Section Ratio for a Spontaneously Fissionable Isomer ^{242f}Am). Jungclaussen, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1967. 12p. (In Russian). Dep.

The property of the saturation of the isomeric ratio was explained. Its experimental value was obtained on the assumption that the isomeric state lies below the minimum between two humps of the fission barrier. (J.S.R.)

40427 (JINR-P7-3424) IZMERENIE MASSOVOGO RASPREDELENIYA OSKOLKOV DELENIYA URANA IONAMI NEONA γ-SPEKTROMETRICHESKIM SPOSOBOM. (The Measurement by γ-Spectrometric Method of Mass Distribution of Uranium Fission Fragments Induced by Neon Ions). Karamyan, S. A.; Liptak, Ya.; Oganesyan, Yu. Ts.; Penionzhkevich, Yu. E.; Urbanets, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1967. 8p. (In Russian). Dep.

A Ge(Li) γ-ray detector was used to measure a total γ-ray spectrum of all the products of uranium fission by accelerated ^{22}Ne ions. In this reaction, the distribution of the fission fragments according to mass was measured without using a chemical separation of the products. (auth)

40428 (NP-16839) ETUDE EXPERIMENTALE DU SPECTRE β^- DE LA TRANSITION $1^- \rightarrow 2^+$ DU ^{186}Re. (Experimental Study of the β^- Spectra of the $1^- \rightarrow 2^+$ Transition of ^{186}Re). Martin, Philippe (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [1964]. 47p. (In French). Dep.

Thesis. Submitted to Univ., Grenoble, France.

The form factor of the $1^- \rightarrow 2^+$ transition of ^{186}Re was studied. After a theoretical review of the β emission, the basic results on the form factor of forbidden transitions and their application to the $1^- \rightarrow 2^+$ transitions of ^{170}Tm, ^{188}Re, and ^{196}Re are reported. The experimental devices used are described. It is shown how the form factor is obtained beginning with the crude counting results. For the $1^- \rightarrow 2^+$ transition of ^{188}Re, no deviation with respect to the statistical form was found. The high value of log ft, the results obtained by other experimenters on the form factor, the circularly polarized β–γ angular correlation, and the directional β–γ correlation tend to show that the correlation is not valid to describe the $1^- \rightarrow 2^+$ transition of ^{186}Re. It was found however that this transition has a permitted form which supports the ξ approximation. Identical contridictions were found in the study of the $1^- \rightarrow 2^+$ of ^{170}Tm, and the results seem insufficient with respect to ^{188}Re. (J.S.R.)

40429 (RLO-1388-23) ANNUAL REPORT [ON NUCLEAR PHYSICS], JUNE 1967. (Washington Univ., Seattle. Nuclear Physics Lab.). Contract AT(45-1)-1388. 114p. Dep. CFSTI.

DEUTERIUM—proton differential elastic scattering cross section at 4 to 11 MeV, excitation function for, (E)

HELIUM-3—energy levels from proton elastic scattering by deuterium at 4 to 11 MeV, (E)

MAGNESIUM-24—alpha inelastic scattering at 15 to 23 MeV, angular distributions and phase correlation coefficients for, (E); alpha reactions (α,t) with, angular distribution for, (E); energy levels from proton elastic scattering by sodium-23, T = 2, (E)

CALCIUM-40, -42, -44, -48—alpha differential elastic scattering cross sections at 42 MeV, angular distributions of

CARBON-12—deuteron elastic scattering at 21 MeV, optical-model potential for, (E); alpha reactions (α,n) at 22 MeV, proton angular distributions and spectra from, (E); helium-3 inelastic scattering at 21 MeV, spin-flip probability for, (E)
NICKEL-58—deuteron elastic scattering at 21 MeV, optical-model potential for, (E); proton inelastic scattering at 9, 11, and 15 MeV, spin-flip probability for, (E)
OXYGEN-16—deuteron elastic scattering at 21 MeV, optical-model potential for, (E); oxygen-16 reactions (O-16,α) at 31 to 37 MeV, differential cross sections for, (E)
SULFUR-32—deuteron elastic scattering at 21 MeV, optical-model potential for, (E); energy levels from oxygen-16 (O-16,α) reactions at 31 to 37 MeV, (E)
RUBIDIUM-87—energy levels from alpha elastic and inelastic scattering at 42 MeV, spins and parities of, (E)
CERIUM-140—energy levels from alpha inelastic scattering, deformation parameters, spins, and parities for, (E)
LEAD-206—proton differential elastic and inelastic scattering cross sections at 10 to 16 MeV, (E)
LEAD-207—energy levels from proton elastic and inelastic scattering by lead-206, isobaric analog, (E)
BISMUTH-207—energy levels from proton elastic and inelastic scattering by lead-206, isobaric analog, (E)
MOLYBDENUM-92—deuteron reactions (d,np) at 6 to 16 MeV, through isobaric analog resonances
ZINC-68—deuteron reactions (d,np) at 6 to 16 MeV, through isobaric analog resonances
ZIRCONIUM-90—deuteron reactions (d,np) at 6 to 16 MeV, through isobaric analog resonances; proton inelastic scattering at 6 to 7 MeV, differential cross sections and spin-flip probability for, (E); deuteron reactions (d,p) at 11 MeV, proton angular distributions from, (E)
ZIRCONIUM-94—deuteron reactions (d,np) at 6 to 16 MeV, through isobaric analog resonances
NUCLEI—deuteron reactions (d,np) with Z = 13 to 82, through isobaric analog resonances, (E); energy-level transitions from (α,3n) and (α,4n) reactions, γ intensity distributions from rotational E2, (E); neutron emission and fission at moderate excitation energies, (E)
GOLD-197—helium-3 reactions (He-3,α) at 23 MeV, α energy spectra from, (E)
TIN-118—helium-3 reactions (He-3,α) at 23 MeV, α energy spectra from, (E)
NICKEL-64—alpha reactions (α,t) with, angular distributions for, (E); proton inelastic scattering at 11 and 14 MeV, spin-flip probability for, (E)
SILICON-30—alpha reactions (α,t) with, angular distributions for, (E)
BORON-11—alpha reactions (α,Li-7) with, triton widths from, (E)
FLUORINE-19—alpha reactions (α,Li-7) with, triton widths from, (E)
NITROGEN-15—alpha reactions (α,Li-7) with, triton widths from, (E)
NIOBIUM-91—energy levels from proton inelastic scattering by zirconium-90, isobaric analog, (E)
GERMANIUM-72—energy level transitions from proton inelastic scattering, two-photon emission in, (E)
GAMMA RADIATION—intensity distributions from rotational E2 transitions following (α,3n) and (α,4n) reactions, (E); detection and measurement at high energy, using sodium-iodide scintillation detectors
BISMUTH-209—proton reactions (p,γ) at 15 and 16 MeV, cross section and γ spectra for, (E)
SODIUM-23—proton elastic scattering at 3.8 to 4.2 MeV, excitation function for, (E); proton reactions (p,α) at 3.8 to 4.2 MeV, excitation function for, (E)
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INVARIANCE PRINCIPLES—time reversal testing using magnesium-24 (d,p) and magnesium-25 (p,d) reactions, (E)
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COMPUTERS—use on-line of SDS 930, with FORTRAN linking
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RADIATION TARGETS—fabrication using high-vacuum evaporation
VAN DE GRAAFF ACCELERATORS—experimental facilities for tandem, development of 24-in. scattering chamber; development of tandem
ION SOURCES—development of negative, for tandem Van de Graaff accelerators (D.C.W.)

40430 (RPI-328-87, pp 1-21) NEUTRON CROSS SECTIONS. (Rensselaer Polytechnic Inst., Troy, N. Y.).

Neutron capture yields divided by sample thickness (in units of atoms/barn) were obtained for 0.25-in. thick Fe and 0.12-in. thick Ni samples over the neutron energy range from 40 to 200 keV using 1.3- and 5-nsec/meter resolution. Doppler widths for capture neutron resonances in Al, Fe, Ni, and W isotopes are plotted at 0 to 600 keV, 0 to 70 keV, 0 to 600 keV, and 0 to 3.5 MeV, respectively. (S.F.L.)

40431 (UCRL-17636) g FACTOR OF THE 243-keV LEVEL IN ^{86}Y. Treytl, William J.; Matthias, E. (California Univ., Livermore. Lawrence Radiation Lab.). June 1967. Contract W-7405-eng-48. 12p. (CONF-670812-6). Dep. CFSTI.

From International Conference on Hyperfine Interactions, Pacific Grove, Calif.

The g-factor and half life of the 243-keV 2$^-$ state in ^{86}Y were measured. The values obtained are g = −0.53 ± 0.03 and $t_{\frac{1}{2}}$ = 28.5 ± 2.1 nsec. The g-factor favors the configuration $[(p_{\frac{1}{2}})_\pi (d_{\frac{5}{2}})_\nu]_2$-. (auth)

40432 (WASH-1074) REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP MEETING, HELD AT BROOKHAVEN, NEW YORK, APRIL 13-14, 1967. Motz, H. T. (comp.) (European-American Nuclear Data Committee). Contract W-7405-eng-36. 153p. (EANDC(US)-99U; INDC(US)-9U). Dep. CFSTI.

CHROMIUM—neutron scattering at 0.35 to 0.965 MeV, differential cross section and polarization for
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SILICON-30— deuteron differential elastic scattering cross sections at 3.2, 3.7, and 3.9 MeV
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ZIRCONIUM HYDRIDES— neutron differential inelastic scattering cross section at 0.24, 0 40, 0.57, and 0.67 eV
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OXYGEN-15— energy-level transitions from oxygen-16 (γ,n) reactions in giant resonance region
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LEAD-206— energy levels from electron inelastic scattering
LEAD-207— energy levels from electron inelastic scattering
LEAD-208— energy levels from electron inelastic scattering (D.C.W.)

40433 (LA-tr-67-16) DELAYED NEUTRONS IN THE FISSION OF ^{232}Th, ^{235}U, AND ^{238}U. Maksyutenko, B. P. Translated by A. D. Cernicek (Los Alamos Scientific Lab., N. Mex.), from Byull. Inform. Tsentra Yadern. Dannym, No. 3, 75-84[1966]. 11p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The effect of the (n,nf) reaction on the yield ratios of delayed-neutron groups from the fission of ^{232}Th, ^{235}U, and ^{238}U at neutron energies of 5 to 7.75 MeV was investigated. The analysis of the decay curves was made using a digital computer with fixed values of the decay constants. (D.C.W.)

40434 EXCITATION FUNCTIONS FOR REACTIONS ^{109}Ag(p,n)-^{109}Cd, ^{109}Ag(d,2n)^{109}Cd, AND ^{107}Ag(α,2n + pn) AND YIELD OF RADIOISOTOPE ^{109}Cd. Dmitriev, P. P.; Konstantinov, I. O.; Krasnov, N. N. At. Energ. (USSR), 22: 310-12(Apr. 1967). (In Russian).

Foil bundles and thick samples of natural silver were irradiated with 22-MeV protons, 21-MeV deuterons, and 42-MeV alpha particles. The integral irradiation current was measured by the ^{65}Zn activity induced in copper foils and also by means of an accurate current integrator. The ^{109}Cd activity was separated radiochemically and was counted on a 40 × 50 mm NaI(Tl) well counter equipped with a 100-channel amplitude analyzer. The excitation functions were calculated for the above reactions and were found to be in good agreement with the thick target yields of ^{109}Cd. The cross sections had maxima of 350 mbarns with 10-MeV protons for the (p,n) reaction, 620 mbarns with 14-MeV deuterons for the (d,2n) reaction, and 1000 mbarns with 27-MeV alpha particles for the (α,2n) reaction. The corresponding yields in millicuries of ^{109}Cd per μA-hr were 1.5 for the (p,n) reaction 4.0 for the (d,2n) reaction and about 1.0 for the (α,2n) reaction. The (d,2n) reaction was the most productive. (TTT)

40435 ELECTROMAGNETIC TRANSITIONS IN CERTAIN ODD NUCLEI. Starodubtsev, S. V.; Begzhanov, R. B.; Teshabaev, K. T.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 3, 45-52(1967). (In Russian).

Previously obtained data on the excited state half lives of odd isotopes ^{127}I, ^{129}I, ^{131}I, ^{139}La, ^{147}Pm, ^{151}Pm, ^{153}Eu, and ^{199}Au were used in theoretical determination of the probabilities of magnetic dipole and electric quadrupole transitions in odd isotopes described by a small nonaxial model without separation into single- and collective-particle excitations. The data obtained on transition probabilities were compared with experiment and the half-life measurements with the predictions of a single-particle model and a pair model plus quadrupole forces. The analysis of magnetic dipole and electric quadrupole reduced transition probabilities in odd I, La, Pm, Eu, and Au isotopes showed that electromagnetic transitions between low-lying and ground states in odd nuclei with various equilibria are well described by a nonaxial model. The probability M-1 and E-2 components of l-forbidden M-1 transitions in these nuclei calculated with the nonaxial model varied not more than by the order of one. Consideration for the influence of deformation could bring even closer agreement between the theoretical and experimental data. (R.V.J.)

40436 SPECTROSCOPY OF ^{113}In. Begzhanov, R. B.; Gladyshev, D. A.; Sabirov, Kh.; Khodzhaev, M. Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 3, 57-62(1967). (In Russian).

An analysis was made of the characteristics of ^{113}In lifetimes of excited states 865, 829, and 598 keV and of the γ-γ angular correlations at 36 to 493 and 231 to 261 keV. The fast-delayed coinci-

dence scheme was used for measuring ^{115}In excitation lifetimes with time lag–amplitude converter for selecting fast coincidences. The reaction ^{114}Cd(n,γ)^{115}Cd in a thermal neutron flux was used as the source. The same installation with adjustments for selecting weak photopeaks was used for the angular γ-γ correlations. (R.V.J.)

40437 ENERGETIC GAMMA RAYS OF ^{192}Ir. Schellenberg, L. (Univ., Freiburg, Switzerland). Helv. Phys. Acta, 40: 639-44(1967). (In German).

The higher-energy gamma spectrum resulting from the decay of ^{192}Ir was studied with Li drifted Ge detectors. Gamma-ray energies and intensities are given for the transitions above 800 keV and for some prominent lines at lower energy. No new lines were found. Two recently reported transitions at 1115 and 1459 keV cannot be attributed to the Ir decay. (auth)

40438 EXPOSURE RATES FROM THE PRODUCTS OF FAST NEUTRON FISSION OF ^{235}U AND ^{238}U AT SELECTED TIMES AFTER FISSION. Bunney, Leland R.; Sam, Daniel (Naval Radiological Defense Lab., San Francisco). Health Phys., 13: 1033-7(Sept. 1967).

The exposure rates per fission per square centimeter at 3 ft above a uniformly contaminated plane were calculated for nine selected times (0.25, 0.5, 1, 2, 5, 10, 24, 48, and 72 hr) after fast neutron fission of ^{235}U and ^{238}U. The calculations were made from recent experimentally determined gamma-ray spectra of the fission products. The results of the calculation of exposure rates from these experimental gamma-ray spectra of unfractionated fission products of ^{235}U and ^{238}U are compared graphically with those based on calculated spectra and with those computed from the few earlier experimental spectra taken at comparable times. (auth) (UK)

40439 STRUCTURE OF PARTICLE-HOLE STATES IN ^{138}Ba. Morrison, G. C.; Williams, N.; Nolen, J. A. Jr.; von Ehrenstein, D. (Argonne National Lab., Ill.). Phys. Rev. Lett., 19: 592-4 (Sept. 4, 1967).

Neutron particle-hole states in ^{138}Ba were observed in three different reactions: from the decay of isobaric analog resonances formed by the reaction ^{138}Ba + p, in the reaction ^{137}Ba(d,p)^{138}Ba, and as isobaric analog states in proton scattering from ^{137}Ba. It is thus possible to make reasonable assignments of spin and parity as well as to determine the shell-model configurations of many of these states. (auth)

40440 INVESTIGATION OF THE 1.4-MINUTE FISSIONING PRODUCT IN THE REACTION ^{230}Th + ^{10}B. Kuznetsov, V. I.; Skobelev, N. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 5: 1136-7(May 1967). (In Russian).

It was previously found that irradiation of ^{230}Th by ^{10}B ions results in the formation of a spontaneously fissioning product, possessing a half-life of 1.4 ± 0.25 min. A similar, 1.2 mg/cm^2 thorium target was irradiated for 4 minutes; half-life measurement yielded the earlier result. A bell-shaped curve with a half-width of about 1.4 MeV was obtained for the excitation function which was graphically derived, standardizing it to an integral flux of 2.53 × 10^{17} of ^{10}B ions. The cross section of formation at the maximum of the excitation, function, $E_{^{10}B}$ = 89 ± 2 MeV, was found to be σ = 2.3 ± 0.4 × 10^{-33} cm^2. The shape of the excitation function does not exclude the possibility of the complete fusion of the target nuclei and the incident ions with the subsequent evaporation of x nucleons. It is very probable that the ^{230}Th(^{10}B,8n)^{232}Am reaction takes place. The ^{232}Am nucleus undergoes spontaneous fission upon K capture. (TTT)

40441 DECAY OF ^{96g}Tc AND ^{96m}Tc. Cesareo, R.; Frevert, L.; Flammersfeld, A. (Univ., Goettingen, Ger.). Z. Phys., 205: 174–80(1967). (In German).

The γ spectra of ^{96g}Tc (103 h) and ^{96m}Tc (51.5 min) were investigated using Ge(Li) detectors. In the decay of ^{96m}Tc γ transitions of 480, 720, 779, 851, 1094, 1201, and 1499 keV were identified. These results are only compatible with spin and parity 7$^+$ and 4$^+$ for ^{96g}Tc and ^{96m}Tc , respectively. γ-γ coincidence measurements yielded a revised level scheme of ^{96}Mo. (auth)

40442 CALCULATION OF RESONANCE INTEGRALS AND INITIAL CONVERSION RATIOS OF ROD CLUSTER FUEL ELEMENTS. Mueller, A.; Riekert, H. (Siemens Schuckertwerke AG, Erlangen, Ger.). Nukleonik, 10: 81-7(July 1967).

A method which allows the calculation of resonance integrals and initial conversion ratios for the individual rings of rod-cluster fuel elements with circular symmetry is developed. The method is checked against experimental values. (auth)

40443 MEASUREMENT OF (n,2n) CROSS SECTIONS BY THE FERMI WATERTANK METHOD. Feicht, E.; Vonach, H. (Technische Hochschule, Munich). Nukleonik, 10: 58-64(July 1967). (In German).

It is shown that the "Fermi-watertank-method" for absolute measurements of neutron source strength may also be used for determination of (n,2n) cross sections; this method was applied to the measurement of the (n,2n) cross section of bismuth. The measurements are similar to those of Heusch. A T(d, n) ^{4}He source is surrounded by a hollow sphere consisting of the element to be measured. The energy spectrum of the neutrons after having passed through the Bi consists out of a line of 14-MeV neutrons which have suffered no energy loss and additionally out of a Maxwell distribution of evaporation neutrons ($\bar{E} \approx 2$ MeV). The spatial distribution of the thermal neutron flux in the water tank surrounding the sphere is measured by activation of gold foils. As the thermal flux distribution produced by the evaporation neutrons decreases much more rapidly with the distance from the source than does the distribution produced by the primary neutrons (at r = 60 cm the evaporation neutron flux distribution has almost disappeared) the flux distribution can be divided quite accurately into its two components. From the intensity of the evaporation neutrons determined in this way, the (n, 2n) cross section can be calculated if the total nonelastic cross section is known. Moreover, the average energy of the evaporation neutrons may be determined from the form of the thermal flux distribution produced by them. For Bi a cross section σ (n, 2n) $\bar{E}$ = 2.25 ± 0.25 b and $\bar{E}$ = 2.00 ± 0.2 MeV was found. This value is in good agreement with other measurements. (auth)

40444 ISOMERIC RATIOS IN NUCLEAR REACTIONS WITH ISOTOPES ^{190}Ir, ^{196}Au, AND ^{242}Am IN THE FINAL STATE. Flerov, G. N.; Gangrskii, Yu. P.; Markov, B. N.; Pleve, A. A.; Polikanov, S. M.; Yungklaussen, Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 6: 17-21(July 1967). (In Russian).

The isomeric ratios in the nuclear reactions producing the isotopes ^{190}Ir, ^{196}Au, and ^{242}Am were studied. The dependence of these ratios is obtained on the mean angular momentum l contributed by the bombarding particle. On the basis of the experimental results the conclusion is drawn on the small spin value of the spontaneously fissioning isomer ^{242}Am. (auth)

40445 FRACTIONAL YIELDS OF DELAYED NEUTRONS AT THE ^{233}U FISSION BY NEUTRONS WITH ENERGIES OF 5.5 TO 7.3 MeV. Maksyutenko, B. P. Yadern. Fiz., 6: 22-3(July 1967). (In Russian).

Fractional yields of delayed neutrons in ^{233}U fission by neutrons with maximum energies of 6, 6.2, 6.4, and 6.8 MeV are measured. A sharp variation of the yield branching is observed in the region where the (n, nf) reaction proceeds. (auth)

40446 K-FORBIDDEN ISOMERIC E1 TRANSITION IN ^{170}Tm. Berestovoi, A. M.; Kondurov, I. A.; Loginov, Yu. E.; Peker, L. K. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 6: 3-5(July 1967). (In Russian).

A double coincidence spectrometer with a Ge counter in one channel and a scintillation counter in the other channel was used to investigate the delayed γ emission from the reaction ^{169}Tm(n, γ)^{170}Tm. The energy of the isomeric transition ($T_{\frac{1}{2}}$ = 4.27 usec) is made more precise: E = 144.5 KeV. The isomeric transition is posed in the scheme of the ^{170}Tm low-lying excited states and is treated as a K-forbidden transition with the forbiddence degree equal to one. The existence is noted of the similar K-forbidden transitions in the nuclei ^{166}Ho and ^{171}Yb due to the identical change of the state of the odd neutron. (auth)

40447 M-SUBSHELL INTERNAL CONVERSION COEFFICIENTS. COMPARISON OF PRESENT CALCULATIONS WITH EXPERIMENTS FOR E2 TRANSITIONS. Dragoun, O.; Jahn, P. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys., A101: 305-20(1967).

Conversion electrons of the 296-, 316-, 468-, and 612-keV transitions in ^{192}Pt and of the 97-keV transition in ^{75}As were measured with the Heidelberg ½ π√13, high-resolution, β-ray spectrometer. The M conversion coefficients were deduced for 19 E2 transitions from intensity ratios measured in this work and those taken from the literature. Theoretical L_3 coefficients were used for the calibration. The results are compared with the predictions of two semi-empirical screening corrections to Rose's unscreened values. The coefficients of Chu and Perlman for the subshells M_3 and M_2 are usually smaller than the experimental ones by 5 and 20%, respectively. There are large deviations in both directions for the subshell M_1. The values of O'Connell and Carroll are unrealistically small. The applicability of effective Coulomb fields in the calculation of internal conversion coefficients is discussed. (auth)

40448 THE ^{91}Zr(d,p)^{92}Zr REACTION AT E_d = 6.25 MeV. Dickens, J. K.; Eichler, E. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Nucl. Phys., A101: 408-16(1967). (ORNL-TM-1868).

The reaction $^{91}Zr(d,p)^{92}Zr$ was studied at $E_d = 6.25$ MeV. Energies for 31 levels in ^{92}Zr were determined, and angular momentum transfer values were obtained for 15 of these levels. The differential cross-section data were compared with distorted-wave calculations, some of which used nonlocal potentials. (auth)

40449 ABSOLUTE MEASUREMENT OF THE DIFFERENTIAL CROSS SECTION FOR COHERENT SCATTERING OF 662-keV GAMMA RAYS BY LEAD. Quivy, R. (Faculte Polytechnique, Bergen). Nucl. Phys., A101: 417-23(1967). (In French).

An experimental method for an absolute measurement of the gamma coherent scattering differential cross section is proposed. An experiment was carried out with 662-keV γ rays scattered by lead for angles from 30 to 160°. The results are in good agreement with several theoretical formulas for scattering angles from 30 to 90° and with the Franz formula for scattering angles to 130°. Above 130°, an important discrepancy with the theory was found. (auth)

40450 CROSS SECTION FOR PRODUCTION OF ELECTRON–POSITRON PAIRS IN XENON BY γ QUANTA OF 2.5 GeV ENERGY. Nichiporuk, B. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 5: 1324-5(June 1967). (In Russian).

On photographs obtained by irradiating a 55-cm Xe chamber with a beam of mesons (π^-) having a momentum of 9 GeV/c, gamma quanta satisfying the following criteria were selected: the flight direction of the gamma quanta did not intersect with the lateral walls of the chamber; the shower length formed by the gamma quantum is greater than 17 cm; the minimum thickness of xenon liquid for the conversion of gamma quanta is equal to 17 cm; and the gamma quanta energy is greater than 2 GeV. A total of 25,000 photographs were scanned, and more than 600 gamma quanta satisfying the above criteria were found. The coefficient for absorption of gamma quanta in Xe was found to be $\mu = 0.1915 \pm 0.005$ cm^{-1}. The total cross section for pair formation by 2.5 GeV gamma quanta in Xe was $\sigma_k = 19.15 \pm 0.50$ barns. This value agrees well with the theoretical value for Xe. (TTT)

40451 LEVELS IN ^{168}Er. Harlan, R. A.; Sheline, R. K. (Florida State Univ., Tallahassee). Phys. Rev., 160: 1005-10(Aug. 20, 1967).

Deuterons of 12.0-MeV energy were used to study the levels in ^{168}Er from the reaction $^{167}Er(d,p)^{168}Er$. The ground-state Q value for the reaction was determined as 5541 ± 6 keV. The ground-state rotational band was observed up to the 8+ state. Members of the γ vibrational band were observed from the 2+ state at 823 keV to the 6+ state. In addition, ten states of the $K\pi = 4-$ and 3– bands of the two-neutron configuration [633↑ ± 521↓] were observed. Absolute differential cross sections for the population of these states by the (d,p) reaction are in agreement with theoretical predictions. (auth)

40452 NUCLEAR LEVELS OF ^{162}Dy. Backlin, A. (Uppsala Univ. The Swedish Research Council's Lab., Studsvik, Nykoping, Sweden); Suarez, A.; Schult, O. W. B.; Maier, B. P. K.; Gruber, U.; Shera, E. B.; Hafemeister, D. W.; Shelton, W. N.; Sheline, R. K. Phys. Rev., 160: 1011-34(Aug. 20, 1967).

The nuclear level scheme of ^{162}Dy was studied utilizing a variety of experimental methods. From the reaction $^{161}Dy(n,\gamma)^{162}Dy$, low-energy γ-ray transitions were measured between 40 and ≈1350 keV with a bent-crystal spectrometer, and the (n,e^-) conversion-electron spectrum was investigated in the energy range between 160 and 1300 keV with a double-focusing β spectrometer. Altogether, some 160 transitions were found, and multipolarities were assigned for about 50 of these. High-energy γ rays from neutron capture in ^{161}Dy were measured in the energy region between 4.9 and 8.2 MeV with a Ge(Li) detector operated in the pair mode; 49 transitions were found. Furthermore, the reactions $^{162}Dy(p,p')$, $^{162}Dy(d,d')$, $^{161}Dy(d,p)$, and $^{163}Dy(d,t)$ were studied at 12-MeV beam energy, using a broad-range magnetic spectrograph. Combining the results of all these experiments, a level scheme containing 90% of the intensity of the low-energy (n,γ) spectrum of ^{162}Dy was constructed consisting of the following levels: the ground-state rotational band up to the 8^+ level; the $K = 2^+$ (γ-vibrational) band at 888.22 keV including all members up to the possible 7^+ state; the $K = 2^-$ octupole-vibrational or [411↑ − 523↑] band with the band head at 1148.29 keV and including members up to the tentative 5^- and 6^- levels; the $K = 4^+$ [521↑ + 523↓] band at 1535.89 keV containing members up to the 6^+ and possibly the 7^+ level; a $K = 0^-$ band (probably octupole) with 1^- and 3^- members at 1275.4 and 1357.0 keV, and possibly the 5^- member at 1520 keV; a tentative $K = 0^+$ band with 2^+ and 4^+ members at 1206.1 and 1390.3 keV, suggesting the 0^+ level at 1127 keV; the $K = 1^+$ [521↑ − 523↓] band at 1745 keV containing states up to the 6^+ level; the $K = 3^-$ [642↑ + 521↓] band at 1770 keV containing levels up to the 6^- member; and finally the $K = 2^-$ [642↑ − 521↓] band at 1866 keV containing levels up to the 5^- state. Other unassigned levels were found above 1.4 MeV in the (d,p), (d,t), and high-energy (n,γ) measurements. The agreement between experimental and calculated cross sections for the (d,t) and (d,p) reactions was found to be good for the [521↑ ± 523↓] and the [642↑ ± 521↓] states, but not so good for the [642↑ ± 523↓] states. The neutron binding energy in ^{162}Dy was determined as 8192.8 ± 3 keV. (auth)

40453 DECAY OF ^{157}Tb. Naumann, R. A.; Hopke, P. K. (Princeton Univ., N. J.). Phys. Rev., 160: 1035-8(Aug. 20, 1967). (PPAD–614E).

Samples of ^{157}Tb were prepared by irradiating enriched ^{156}Dy in the Materials Testing Reactor. After irradiation, the ^{157}Tb samples were prepared by ion exchange separation and the use of the Bohr Institute's electromagnetic isotope separator. The L_I-to-K electron-capture ratio was determined as 2.65 ± 0.20 using a Be-windowed NaI spectrometer. This value is comparable to previous determinations. It implies a Q value for electron capture to the ground state of ^{157}Gd of 66 ± 6 keV which also permits electron capture to the first excited state at 54 keV. A search was made for photons of this energy using a Ge semiconductor detector having an energy resolution of 0.75 keV. Photons having 54.35 ± 0.05 keV were observed in ^{157}Tb sources. Using the measured photon intensity and the intensity of the K x rays, a branching ratio of (0.34 ± 0.2)% is calculated for electron capture to the first excited state. (auth)

40454 RESONANCE NEUTRON CAPTURE IN THE EVEN-A ISOTOPES OF TUNGSTEN. Prestwich, W. V.; Cote, R. E. (Argonne National Lab., Ill.). Phys. Rev., 160: 1038-42(Aug. 20, 1967).

The γ-ray spectra following neutron capture in the 4.14- and 21.2-eV resonances of ^{182}W and the 18.8-eV resonance of ^{186}W were observed with a 6-cc Ge(Li) detector. Transitions corresponding to the $^{182}W(n,\gamma)^{183}W$ reaction were also observed in the 115- and 250-eV resonances. In a special experiment, using a NaI detector, the absolute width of the ground-state transition for the 4.14-eV resonance in ^{182}W was determined relative to the ground-state transition for the 7.62-eV resonance in ^{183}W. (auth)

40455 MAGNETIC DIPOLE AND ELECTRIC QUADRUPOLE HYPERFINE EFFECTS IN ^{209}Bi MUONIC X RAYS. Bardin, T. T. (Columbia Univ., New York); Cohen, R. C.; Devons, S.; Hitlin, D.; Macagno, E.; Rainwater, J.; Runge, K.; Wu, C. S.; Barrett, R. C. Phys. Rev., 160: 1043- (Aug. 20, 1967).

The muonic x rays from the spherical nucleus ^{209}Bi were detected by Li-drifted Ge detectors with an energy resolution of 0.14% at 6-MeV γ energy. The following information was obtained: (1) The hfs due to the M1 and E2 interactions between the muon and the nuclear charge and magnetic moment distributions was observed. The theoretically predicted splittings based on different nuclear models were compared with the experimental results. (2) The parameters of the spherical charge distribution as described by the "Fermi distribution" were determined from the transition energies of the K and L muonic x rays: $c = (1.126^{+0.008}_{-0.006})A^{\frac{1}{3}}$ fm and $t = 4 \log_e 3\,(0.511^{+0.010}_{-0.008})$ fm. (3) The experimental results confirm the anomalous intensity ratios previously observed in Bi muonic x rays. The observed intensity ratios were $(2p_{\frac{3}{2}} \rightarrow 1s_{\frac{1}{2}}) : (2p_{\frac{1}{2}} \rightarrow 1s_{\frac{1}{2}}) = 1.38 \pm 0.1$, $(3d_{\frac{5}{2}} \rightarrow 2p_{\frac{3}{2}}) : (3d_{\frac{3}{2}} \rightarrow 2p_{\frac{3}{2}}) = 1.5 \pm 0.1$, and $(4f_{\frac{7}{2}+\frac{5}{2}} \rightarrow 3d_{\frac{5}{2}}) : (4f_{\frac{5}{2}} \rightarrow 3d_{\frac{5}{2}}) = 1.29 \pm 0.3$. (4) The cascade transitions in the sequence $4f \rightarrow 3d \rightarrow 2p \rightarrow 1s$ are approximately equal in intensity within an uncertainty of 15%. (auth)

40456 NUCLEAR g FACTORS OF THE FIRST EXCITED 2^+ STATES IN ^{152}Sm, AND ^{154}Sm, AND ^{156}Gd, ^{158}Gd, AND ^{160}Gd. Wolfe, P. J.; Scharenberg, R. P. (Case Inst. of Technology, Cleveland). Phys. Rev., 160: 866-73(Aug. 20, 1967).

The nuclear g factors of the Coulomb-excited 2^+ rotational states in ^{152}Sm, ^{154}Sm, ^{156}Gd, ^{158}Gd, and ^{160}Gd were measured using the pulsed-beam technique. The precession of the excited nuclei in an external magnetic field was detected by observing the angular distribution of the de-excitation γ radiation as a function of time. The measured g factors and mean lives τ were $g = 0.277 \pm 0.028$ and $\tau = 2.12 \pm 0.07$ nsec for the 122-keV state in ^{152}Sm, $g = 0.288 \pm 0.029$ and $\tau = 4.37 \pm 0.07$ nsec for the 82-keV state in ^{154}Sm, $g = 0.296 \pm 0.018$ and $\tau = 3.29 \pm 0.08$ nsec for the 89-keV state in ^{156}Gd, $g = 0.315 \pm 0.025$ and $\tau = 3.69 \pm 0.08$ nsec for the 79-keV state in ^{158}Gd, and $g = 0.303 \pm 0.026$ and $\tau = 3.92 \pm 0.08$ nsec for the 75-keV state in ^{160}Gd. For ^{152}Sm the precession was measured as a function of target temperature in order to understand better the internal field at the nucleus. It was found that the internal field did not have the theoretically expected temperature dependence above room temperature. The Sm results were obtained by using Sm metal targets, which were noticeably perturbed by electric quadrupole interactions. The Gd experiments utilized liquid-metal targets, and no perturbations were observed. (auth)

40457 CAPTURE CROSS SECTIONS OF ^{237}Np. Stupegia, Donald C.; Schmidt, Marcia; Keedy, Curtis R. (Argonne National Lab., Ill.). Nucl. Sci. Eng., 29: 218-19(Aug. 1967).

Neutron-capture cross sections of ^{237}Np were measured at eight neutron energies between 0.15 and 1.5 MeV. The experimental method was the activation technique in which the neptunium target was irradiated with a monoenergetic neutron beam and was analyzed for the product ^{238}Np by gamma-ray spectrometry. (auth)

40458 CONCERNING INFINITELY DILUTE RESONANCE INTEGRALS. Wilkins, Coleridge A.; Thompson, Donald G. (Wollongong Univ. Coll., New South Wales, Australia). Nucl. Sci. Eng., 29: 244-7(Aug. 1967).

The infinitely dilute resonance integral is considered in the unresolved region. The gamma-ray and fission widths are assumed constant so that the height of any resonance depends only on the resonance energy and the reduced neutron width. On the basis of this assumption, the r'th moment of the area under the profile of an isolated resonance may be written as a combination of the integrals $\int_0^\infty (1 + y^2)^{-j} \exp(-Ay^2/2)\, dy$, j = 0, 1, ... r. Any such integral may be expressed in terms of the integrals corresponding to j = 0 and j = 1, which are easily determined. Next, an expression for the r'th moment of the resonance integral is derived for the case where resonances are scattered over an energy interval. In view of the lack of absolute unanimity among workers in this field, the derivation is performed without making any specific assumption about the level spacing distribution, allowance being made for energy dependence. From the results for an isolated resonance, this expression is capable of evaluation for any particular value of r, once the form of the level spacing distribution has been chosen and the resonance density calculated. (auth)

Nuclear Theory

Refer also to abstracts 39807, 40153, 40238, 40244, 40345, 40368, 40420, 40424, 40469, and 40507.

40459 (AWRE-O-35/59) MASS-ENERGY RELATIONSHIPS OF THE ACTINIDE ELEMENTS. Lewis, D. T. (Atomic Weapons Research Establishment, Aldermaston (England)). [nd]. 18p. Dep. CFSTI. UK.

Binding-energy equations that are applicable to all the heavy elements are derived stressing the mass dependence. The application of the equations to the calculation of atomic weights and energies of alpha emission is demonstrated. (D.C.W.)

40460 (AWRE-O-39/59) DISINTEGRATION ENERGIES OF THE ACTINIDES AND RELATED HEAVY ELEMENTS. Lewis, D. T. (Atomic Weapons Research Establishment, Aldermaston (England)). [nd]. 16p. Dep.

Equations are developed which correlate the energies of α emission and the corresponding binding energies of nuclei with the primordial masses of the parent nuclei. The suggestion that isoprotic groups can exist within certain isotopic series is further developed. A general mass-energy equation is derived which is applicable to all the heavy and actinide elements. (auth)

40461 (BARC-279) EVALUATION OF NEUTRON CROSS SECTIONS ON THE BASES OF OPTICAL AND STATISTICAL MODELS. Garg, S. B.; Balasubramanian, K.; Shukla, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1967. 40p. Dep.

In order to produce accurate calculation of the neutronics of reactors, precise knowledge of inelastic and elastic cross sections and their angular distributions is desired. Optical model and Hauser-Feshbach theory were used to compute total, elastic, and inelastic cross sections of several materials which are of special interest from the point of view of a reactor physicist. These calculations also serve to test the validity of these two nuclear models which are frequently used in the continuum energy region. In general, the calculated total cross section agrees well with the measured one. The data presented will be incorporated into multi-group computer codes for reactor analysis. Strength functions can also be calculated on the basis of the optical model. (auth)

40462 (COO-1573-20) MODEL CALCULATIONS IN UNIFIED NUCLEAR REACTION THEORY. Feldman, Lee (Case Inst. of Tech., Cleveland, Ohio. Nuclear Physics Lab.). June 1967. Contract AT(11-1)-1573. 140p. Dep. CFSTI.

Thesis.

The B. C. C. M. formalism proposed by Tobocman and Nagarajan is tested for its usefulness as an approximate method for inelastic scattering calculations. The coupled-square-well model is used to represent the scattering interaction, and this model permits a comparison of the approximate and exact results. Such comparisons indicate that the B. C. C. M. results do not converge rapidly enough such that a moderate order of approximation may be used. It is pointed out, however, that this failure is due to the peculiar nature of the square-well potential and not the formalism itself. The constraint method for bound states proposed by the same authors is also tested on a single-channel scattering problem. Unavoidable difficulties which are inherent in the formalism seem to make the technique unsuitable for use as an approximate scheme. (auth)

40463 (IPNO/TH-91) SOLUTION OF THE NUCLEAR HARTREE-FOCK EQUATIONS IN COORDINATE SPACE. Vautherin, D.; Veneroni, M. (Paris Univ., Orsay (France). Institut de Physique Nucleaire). July 1967. 12p. Dep.

A method is proposed which permits the direct numerical solution of the Hartree-Fock equations for spherical nuclei is proposed. The idea is to replace the nonlocal one-body potential occurring in the Schroedinger equation by a local potential which is state-dependent. The usual HF iteration process is then replaced by a double iteration. The method is simple only with a local two-body interaction. Results of calculations for oxygen-16 and calcium-40 are given using this method. (J.F.P.)

40464 (JINR-P2-3404) ZADACHA DVUKH TEL, VZAIMODEISTVUYUSHCHIKH S NELOKAL'NYM FAKTORIZUYUSHCHIMSYA POTENTSIALOM. (The Problem of Two Bodies Interacting with a Non-Local Factorizing Potential). Tkebuchava, F.; Chilashvili, G. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 18p. (In Russian). Dep.

Factorizing potentials, which can raise the repulsion at small distances, are considered. The phase-shift analysis is performed in the case of interaction when, except for the Yukawa attraction, there exists a potential wall. The parameter values are found for this interaction which well describe the experimental data. (auth)

40465 (JINR-P4-3326) O TOCHNOSTI VYCHISLENIYA ODNOCHASTICHNYKH SOSTOYANII DEFORMIROVANNYKH YADER. (Calculations of Single-Particle States of Deformed Nuclei). Gareev, F. A.; Ivanova, S. P.; Kalinkin, B. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 10p. (In Russian). Dep.

The method of calculating single-particle states depends on diagonalization of the energy matrices to simplify the calculations. The states of the spherical nucleus having a corresponding mass and an average nuclear field described by a Saxon-Woods potential are used as a base. The wave functions of the states of the spherical nucleus can be represented in analytical form. A program for calculating the single-particle states of deformed nuclei on a computer was developed. The accuracy of the results was estimated by comparing the computation with the data of other authors who developed a more accurate method calculation which was based on a numerical solution of the set of differential equations. The single-particle levels were calculated as a function of the deformation β with the change in the spin-orbit interaction being taken into account. In most cases the agreement was excellent. The advantage of the proposed method was that the calculations could be carried out about a factor of 100 faster. (TTT)

40466 (JINR-P4-3354) DVUKHTOCHECHNYE FUNKTSII. (Two-Point Functions). Eganova, I. A.; Shirokov, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 18p. (In Russian). Dep.

It is known that the scattering of a low-energy particle by the potential of small radius is satisfactorily described by the s-wave alone. A method is given for obtaining the functions with the aid of which one can describe by only two waves the scattering by two localized potentials separated by an arbitrary distance 2d. Two-point solenoidal vector functions are also obtained. In the two-center case, they play the same role as the known electric and magnetic multipoles in the one-center problems (e.g., the problems of scattering or emission of a photon in the dipole approximation). (auth)

40467 (JINR-P4-3432) ANGARMONICHESKIE EFFEKTY V CHETNO-CHETNYKH DEFORMIROVANNYKH YADRAKH. (Anharmonic Effects in Even-Even Deformed Nuclei). Dzholos, R. V.; Solov'ev, V. G.; Zheleznova, K. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 8p. (In Russian). Dep.

The admixture of the two-phonon states to the lowest one-phonon states in even-even deformed nuclei removed from the transition regions is considered. It is shown that this admixture is small. It means that the anharmonic effects are not important in even-even deformed nuclei. (auth)

40468 (LYCEN-6729) ETUDE D'UN MODELE DIFFRACTIONNEL POUR LA DIFFUSION ELASTIQUE DE PARTICULES DE MOYENNES ENERGIES. (Study of a Diffraction Model for

Elastic Scattering of Particles of Medium Energies). Meyer, Jacques (Lyon Univ. (France). Faculte des Sciences). May 1967. 110p. (In French). Dep.

Thesis.

The phenomenon of diffraction as it is presented in classical optics is reviewed in order to derive the principal hypothesis which, transposed to nuclear physics, constitutes the basis of diffraction models. Two of these models are then analyzed in order to define certain approximations which, if they are justified from the mathematical viewpoint, have removed from the model a little of its physical reality. The necessary hypotheses are then restudied in order to construct a diffraction model that is closer to the physical mechanism. This model was tested on the elastic scattering $^{208}Pb(n,n)^{208}Pb$ at 14.5 MeV in order to test the validity of the expressions. (J.S.R.)

40469 (NP-16950) OB OPREDELENII PARAMETRA SMESHIVANIYA V RADIATSIONNYKH PEREKHODAKH YADER. (On the Determination Mixing Parameter in the Radiation Transitions of the Nuclei). No. 462. Lobov, G. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1966. 10p. (In Russian). Dep.

The angular correlations of two linearly polarized cascade photons were calculated for the general case of mixed radiative transitions of arbitrary multipolarity of the nucleus. The expressions obtained may be used for a unique definition of mixing parameters from the experimental data. The angular correlations for the nuclei of ^{49}Ti and ^{38}Cl were numerically calculated. (auth)

40470 (ORNL-4152) COMPUTER PROGRAM JUPITOR-1 FOR COUPLED-CHANNEL CALCULATIONS. Tamura, Taro (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 135p. Dep. CFSTI.

The FORTRAN listing and the corresponding description of a computer program named JUPITOR-1 (abbreviated JP1) is presented. This program can be used to perform coupled-channel calculations to evaluate the cross sections for the scattering of nuclear particles by nuclei. Preparations of the input data cards are explained in great detail with illustrations. Ways of possible modification or expansion of the present program are also suggested. (auth)

40471 (ORNL-P-3299) CALCULATION OF NEUTRON-CAPTURE GAMMA-RAY SPECTRA. Yost, K. J. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 5p. (CONF-671102-14). Dep. CFSTI.

For Presentation at 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

A method for calculating capture γ spectra is outlined in which the cascade processes are defined in terms of electric and magnetic dipole and quadrupole transition probabilities and corresponding conditional spin branching probabilities. Allowance is made for predictable variations of reduced intensities among states of like spin and parity. (D.C.W.)

40472 (ORO-2972-34) BRIGIT. Technical Report Number Two. Moore, C. Fred; Parish, Leslie (Texas Univ., Austin. Center for Nuclear Studies). Aug. 17, 1967. Contract AT(40-1)-2972. 20p. Dep. CFSTI.

The computer program BRIGIT which was written to fit proton elastic scattering resonances in order to extract resonance parameters is described. The theoretical formulation is outlined. (D.C.W.)

40473 (PR-P-74) PHYSICS DIVISION PROGRESS REPORT, APRIL 1-JUNE 30, 1967. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). 65p. Dep. CFSTI. CAN $1.50.

RADIATION DETECTORS, SPARK CHAMBER — design for use in focal plane of broad-range magnetic spectrograph
BERYLLIUM — neutron multiplication in annulus of, around ING target
NEUTRON SOURCES — flux depression in ING target moderator; neutron multiplication in beryllium annulus around ING target
GAMMA SPECTROMETERS — design of scintillation-semiconductor three-crystal
MAGNESIUM-25 — energy levels from proton inelastic scattering, lifetime measurements using Doppler shift attenuation
ALUMINUM-27 — energy-level transitions from proton inelastic scattering, lifetime measurements using Doppler shift attenuation
MAGNESIUM-26 — energy levels from proton inelastic scattering, lifetimes and branching ratios for
MAGNESIUM-24 — energy-level transitions from proton inelastic scattering, lifetime measurements using Doppler shift attenuation
SULFUR-32, — energy-level transitions from proton inelastic scattering, branching ratios and lifetime measurements using Doppler shift attenuation
GAMMA RADIATION — production of monoenergetic, using boron-10 (α,p) reactions in boron–plutonium dioxide mixture
GAMMA SOURCES — development of monoenergetic, using boron-10 (α,p) reactions in boron–plutonium dioxide mixture
ERBIUM-171 — beta decay of, γ spectra from
THULIUM-171 — energy levels from erbium-171 beta decay
GADOLINIUM-156, SAMARIUM-152 — energy-level transitions in vibrational band, multipolarities of
YTTERBIUM-177 — energy-level spins and transitions from ytterbium-176 neutron capture
GADOLINIUM-159 — gamma spectra
THORIUM-227 — alpha decay of, satellite bands in conversion-electron spectrum from
RADIUM-223 — conversion-electron spectra of, satellite bands in
RADIATION DETECTORS, SEMICONDUCTOR (GERMANIUM) — performance of lithium-drifted, at 5 to 220°K
RADIOISOTOPES — activity standardization for, international intercomparison for
RADIATION SOURCES — standardization of, international intercomparison for
CRYOSTATS — design for lithium-drifted germanium detectors
POTASSIUM ACID PHOSPHATES — phonon frequency spectrum of deuterated, measurement using neutron inelastic scattering
ERBIUM — spin-wave dispersion relations at 4.2°K
COBALT OXIDES — magnetic excitations in, model for
MANGANESE FLUORIDES — magnetic properties of cobalt-doped, measurements using neutron inelastic scattering
POTASSIUM BROMIDES, RUBIDIUM BROMIDES — KBr–RbBr, phonon frequency spectrum in, measurement using neutron scattering
NEUTRON SPECTROMETERS — development of fast chopper
HELIUM — neutron scattering by liquid, cold
NEUTRONS, COLD — scattering by liquid helium
GAMMA SPECTROMETERS — design of double-flat-crystal
GAMMA RADIATION — energy of, measurement using crystal diffraction
ELECTROMAGNETIC FIELDS — frequency variation with effective shunt impedance of linear accelerator cell
ELECTROMAGNETIC LENSES — design of quadrupole
LINEAR ACCELERATORS — electromagnetic fields in, frequency variation with effective shunt impedance
FISSION — description using shell model
NUCLEAR STRUCTURE — description using theory of Fermi liquids
NUCLEAR REACTIONS — theory of inelastic scattering
SCATTERING — theory of nuclear inelastic
NUCLEAR THEORY — binding energies of three-body systems
NUCLEONS — binding energies of three-body systems of
NUCLEI — binding energies of A = 3
PARAMAGNETIC MATERIALS — neutron scattering cross sections for, temperature dependence of
NEUTRONS — scattering cross sections for paramagnetic materials, temperature dependence of
SOLAR FLARES — detection system for, using teletype transmission
COSMIC RADIATION — intensity of, meteorological effects on measurements of
CHARGED PARTICLES — detection and measurement using magnetic spectrograph
GOLD-197, TANTALUM-181 — deuteron reactions (d,p) with, γ spectra from (D.C.W.)

40474 (RLO-1062-675) PROGRESS REPORT [ON NUCLEAR PHYSICS] FOR YEAR ENDING JULY 31, 1967. (Oregon State Univ., Corvallis. Dept. of Physics). Contract AT(45-1)-1062. 56p. Dep. CFSTI.

COPPER-59 — decay of, γ spectra from
COPPER-61 — beta decay of, γ spectra from
NICKEL-61 — energy-level transitions from copper-61 decay
ALPHA PARTICLES — scattering by zinc-70 at 43 MeV, α spectra from inelastic
ZINC-70 — energy levels from alpha inelastic scattering at 43 MeV
IODINE-125, MANGANESE-54, CADMIUM-109 — electron-capture decay of, bremsstrahlung spectrum from
BREMSSTRAHLUNG — spectra from electron-capture decay of nuclei
NUCLEAR REACTIONS — theory of charge-exchange, in $1f_{\frac{7}{2}}$-shell nuclei
TITANIUM ISOTOPES — helium-3 reactions (He-3,t) with even-even, spectroscopic factors for

NUCLEAR REACTIONS—theory of inelastic scattering, tensor force in
NUCLEI—energy-level transitions in, rate formula for first-order (T)
NUCLEAR REACTIONS (DIRECT)—theory of spin-dependent interaction in, research progress on; theory of, three-body problems in
ZIRCONIUM-90—energy levels from alpha inelastic scattering at 42 MeV (E)
ALPHA PARTICLES—scattering by zirconium-90 at 42 MeV, α spectra from inelastic
CYCLOTRONS—design of Oregon State University, modification of
VACUUM SYSTEMS—design for Oregon State University cyclotron
ION SOURCES—design for production of positive hydrogen ions, for Oregon State University cyclotron
MAGNETIC FIELDS—measurement in cyclotron, using floating wire method (D.C.W.)

40475 (UCRL-17503) LECTURES [ON] INELASTIC SCATTERING AND NUCLEAR STRUCTURE [PRESENTED AT] INTERNATIONAL SCHOOL OF PHYSICS "ENRICO FERMI", COURSE XL, 26 JUNE–15 JULY 1967, VARENNA (COMO), ITALY. Glendenning, Norman K. (California Univ., Berkeley. Lawrence Radiation Lab.). Contract W-7405-eng-48. 83p. Dep. CFSTI.

The theory of inelastic scattering and its applications to the study of the properties of individual nuclear states are reviewed. (D.C.W.)

40476 (UJV-1789) VLIV T-NEINVARIANTNOSTI JADERNYCH SIL NA KORELACNI FUNKCI KASKADY GAMA-KVANT. (The Effect of T-Noninvariance of Nuclear Forces on the Correlation Function of Gamma Ray Cascade). Kajfosz, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1967. 29p. (In Czech). DTIE.

The magnitudes of anomalous terms which are proportional to the imaginary part of the mixing ratio of two multipole orders in the correlation function of gamma cascades from the de-excitation of oriented nuclei are discussed. A general expression for the directional correlation function is given. Particular quantities are tabulated for the spins 0 to 7 of the respective levels and for the lowest-order multipolarities. As an application example the value of A is calculated for the $\frac{1}{2} \rightarrow \frac{3}{2} \rightarrow \frac{1}{2}$ cascade in the ^{49}Ti nucleus (A = 0.0165 sinγ'). The optimum values of individual quantities, and in this way the most appropriate physical conditions for testing the T invariance by this method, are found. It is shown that A attains a value which is up to 60 times higher than for ^{49}Ti, which leads to the conclusion that the upper limit of the time-noninvariant part of the strong interaction could be decreased substantially, as soon as an experimentally convenient object is successfully found. (auth)

40477 ANTIPROTON CHARGE EXCHANGE ON NUCLEI. Fiveiskii, Yu. D. (Moscow Engineering-Physics Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 2, 29-33(1967). (In Russian).

A method for the calculation of the cross section of $\bar{p}$ charge exchange on average and heavy nuclei, using the optical potential of the nuclei to which the charge-exchange operator $V(r)\tau$ was added, is reported. The method is valid for energies $P_{\bar{p}}^2/2M\bar{p} >> (M\bar{n} - M\bar{p})c^2$. The apparent form of the differential and complete cross sections of the charge exchange was obtained for optical potentials in the form of complex rectangular hole $V(r) = V_0$, where V_0 differs from zero inside the nucleus and $P_{\bar{p}}^2/2M\bar{p} >> 2^2e^4M\bar{p}/2\hbar^2$. For such a form of the optical potential, the size V_0 of the corresponding experimental value of the total cross section of $\bar{p}$ charge exchange on Pb nuclei was found. The dependence of the total cross section of charge exchange on V_0 in Cu nuclei was determined. (tr-auth)

40478 RESIDUAL INTERACTIONS IN SPHERICAL SYMMETRIC NUCLEI. Hadermann, J.; Simonius, M. (Univ. of Basel). Helv. Phys. Acta, 40: 531-8(1967).

By introducing a residual two-body interaction in the shell model, the low-lying states are shown to be similar to collective vibrations. Energies, state vectors, and transition rates are evaluated in the quasi-boson approximation which is exact for only one pair of nucleons outside the closed shell. Numerical results for some Pb and Ni isotopes are given. (auth)

40479 POSSIBLE ORIGIN OF REPULSIVE CORE AND SPIN-ORBIT FORCES IN THE NUCLEON-NUCLEON INTERACTION. TRIPLET ODD STATE. Sato, Masahiro; Tamagaki, Ryozo (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto), 37: 1147-66(June 1967).

The repulsive core in the nucleon–nucleon interaction can be described by the nonlocal exchange kernel originating from the many-unfermion structure of the nucleon core. This description of the repulsive core, although phenomenological, is valid in the triplet odd state, as well as in the singlet even state treated previously by Otsuki, Tamagaki and Yasuno. It is also discussed, in connection with the problem, to what extent the short-range spin-orbit force can be ascribed to the core region, by assuming that it results from spin-orbit forces between fundamental urbaryons. (auth)

40480 NUCLEAR COLLECTIVE ROTATION IN THE RANDOM PHASE APPROXIMATION. Kammuri, Tetsuo (Osaka Univ.). Progr. Theor. Phys. (Kyoto), 37: 1131-46(June 1967).

The collective rotation in deformed nuclei is described in the random phase approximation (RPA). The RPA Hamiltonian can be separated into a rotational and an intrinsic part. The phase angle conjugate to the angular momentum is introduced to describe the rotational motion. The collective rotational mode corresponds to the zero-frequency eigenmode of the RPA Hamiltonian. As a result, the spurious states arising from vibrations of the symmetry axis about its assumed direction have zero energy. The formula for the moment of inertia of the ground state rotational band of even-even nuclei agrees with that given by Thouless or Thouless and Valatin. The case in which the Hartree-Fock ground state has non-vanishing eigenvalue of J_z, as in odd-A nuclei is also treated: the rotational Hamiltonian is compared with that originally given by Bohr and Mottleson. In such a case, a method is proposed to extend the cranking model formula for the moment of inertia. (auth)

40481 ^{6}Li(p,2p)^{5}He REACTION AND ALPHA–DEUTERON CLUSTER MODEL FOR ^{6}Li. Saito, Sakae; Hiura, Jun; Tanaka, Hajime (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto), 37: 1351-3(June 1967).

Some features of quasi-free p–p scattering by ^{6}Li are explained by the α–d cluster model of ^{6}Li, using the unboundness of ^{5}He. The plane-wave impulse approximation is used for the primary process of the p–p collision in ^{6}Li, and the final-state interaction theory is applied to the subsequent n–α breakup of ^{5}He. Results are given for E_p = 155 MeV. (S.F.L.)

40482 NEUTRON INDUCED REACTIONS. Haque, Md. Aminul (Atomic Energy Centre, Dacca, Pakistan). Nucl. Sci. Appl., 2: No. 2, 20-5(Oct. 1966).

A review of nuclear-reaction theories is given. It has been observed that while the direct-reaction theory is more appropriate in interpreting the results of neutron-induced reactions around 14 MeV, contributions from compound nucleus formation have also been noticed at low energy, particularly in the (n, α) reaction. (auth)

40483 THE AKHIESER–POMERANCHUK–BLAIR MODEL IN NUCLEAR SCATTERING. Sen Gupta, Hiranmoy (Univ. of Dacca, Pakistan); Rahman, Mizanur. Nucl. Sci. Appl., 2: No. 2, 13-19 (Oct. 1966).

The semi-classical Akhieser–Pomeranchuk–Blair model is discussed. The effect of the parameter variation on the angular distribution of the scattering cross section is shown, and a survey of the analyses of the elastic scattering data using the APB model is made. (auth)

40484 NEW RESULTS RELATED TO FUNDAMENTAL INTERACTIONS IN NUCLEAR SPECTROSCOPY. Berenyi, Denes (Nuclear Research Inst., Debrecen, Hungary). Magy. Fiz. Foly., 15: 173-92(1967). (In Hungarian).

One of the most important fields of nuclear spectroscopy is related to the study of the mechanism of processes, such as decay, branching, secondary reactions, etc., complementing the investigation on nuclear structures and interactions. The most important recent studies in the field of nuclear spectroscopy, of interest for weak interactions, are reviewed. The fields examined include the nonconservation of parity in interactions between neutral and charged nucleons, reviewing specifically the transitions occurring during the decay of ^{181}Hf; the conserved vector current theory for μ decay, and the pure Fermi-type β transitions; weak magnetism and form factors, involving the analogy between the isovector portion of the electromagnetic current and the weak vector current; nonconservation of the G-parity; charge mirroring and charge conjugation; invariance of time inversion in strong interactions; the Fierz interference term, and pseudoscalar interaction in β decay. The problems discussed are of special interest for the program of the Debrecen Nuclear Research Institute. (Review article, 81 references). (TTT)

40485 CURRENT PROBLEMS OF HIGH-RESOLUTION SPECTROSCOPY. Tatu, V. S. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 19: 617-64(1967). (In Rumanian).

The recently developed precise experimental technique of high-resolution spectroscopy makes it possible to study conveniently important physical phenomena, such as the hyperfine and isotopic

structure of spectral lines. In addition to its application to a large number of fields related to the structure of matter, the method is also used in industry for carrying out otherwise impossible high-precision analytical investigations. The equipment used includes improvement of old apparatus, such as the Fabry-Perot interferometer and the diffraction grating, together with the most modern tools, such as lasers. Photographic and photoelectric methods are used for recording. The main applications of high-resolution spectroscopy in nuclear physics include position determinations which are important for measuring nuclear spin magnetic moments and electric nuclear quadrupole moments; intensity measurements are of interest for nuclear spin determinations and for isotopic composition analyses. Use of lasers in interference spectroscopy made it possible to measure the isotopic displacement between ^{20}Ne and ^{22}Ne. (Review article, 94 references). (TTT)

40486 ORBITAL FRACTIONAL PARENTAGE COEFFICIENTS FOR THE HARMONIC OSCILLATOR SHELL MODEL. Kramer, P. (Univ., Tuebingen, Ger.). Z. Phys., 205: 181-98(1967).

The Hamiltonian of n particles moving in a common harmonic-oscillator potential has as its symmetry group the unitary group U(3n) in 3n dimensions. n-particle states of the harmonic oscillator shell model can be characterized as bases of irreducible representations (BIR) of the group U(3n) and of certain subgroups of this group. Use is made of these subgroups for the factorization and calculation of 2-, 3-, and 4-particle fractional parentage coefficients (fpc) of the harmonic oscillator shell model. Recoupling coefficients for subgroup chains of the symmetric group S(n) appear as factors in the fpc. These coefficients are analyzed and are calculated explicitly. The 2-, 3-, and 4-particle fpc of the 1s1p-shell configuration are obtained as products of these recoupling coefficients with known reduced Wigner coefficients of the unitary group U(3) in 3 dimensions. Possible applications are indicated. (auth)

40487 EXACT DISTRIBUTIONS OF THE REDUCED-WIDTH AMPLITUDE. Ullah, Nazakat (Tata Inst. of Fundamental Research, Bombay). J. Math. Phys. (N. Y.), 8: 1095-6(May 1967).

The invariance hypothesis is used to derive the various multivariate distributions of the reduced-width amplitude. Simple expressions are given for the multilevel and multichannel distributions valid for all dimensions of the random orthogonal matrix. (auth)

40488 MISSING RESONANCES. Wilkins, C. A. (Wollongong Univ. Coll., New South Wales, Australia). J. Nucl. Sci. Technol. (Tokyo), 4: 313(June 1967).

Equations are given which statistically predict the average number of resonances missed between observed resonances in an experimental interval of energies. (S. F. L.)

40489 SLOW NEUTRON SCATTERING AND SPACE-TIME CORRELATION FUNCTIONS. Sunakawa, Sigenobu; Yamasaki, Shuichiro; Nishigori, Takeo (Osaka Univ.). Progr. Theor. Phys. (Kyoto), 37: 1051-79(June 1967).

The cross section for neutron scattering is studied in the light of a new space-time pair correlation function which is real and positive, and it is possible to give it a simple physical interpretation as a probability. A well-defined classical limit of the scattering cross section is presented on the basis of the new formalism, which takes correct recoil effects into account. Three simple illustrative examples are treated in the formalism. (auth)

40490 DETERMINATION OF THE PROBABILITY THAT A CHANNEL OF A NUCLEAR REACTION REALIZES. Moroz, V. I.; Nikitin, A. V.; Troyan, Yu. A.; Shakhbazyan, B. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 6: 90-3(July 1967). (In Russian).

The problem is considered of discrimination of recorded events between channels of nuclear reactions. From the maximum likelihood method, the general expression is deduced for the probability that a channel of a nuclear reaction does realize. The problems under discussion are distinction between reaction channels that have equal numbers of relations implied over the process parameters, and distinction between reaction channels with different numbers of relations. It is shown that if X^2_{min} for the hypotheses considered lies in the admissible intervals, then in a number of practically important cases the hypothesis should be preferred corresponding to the largest number of relations. (auth)

40491 THEORETICAL ANGULAR DISTRIBUTION CURVES FOR REACTIONS WITH ENTRANCE CHANNEL SPIN 1/2. Taras, P. (Univ., Montreal). Nucl. Instrum. Methods, 54: 153-4(Sept. 1967).

Theoretical angular distribution curves have been computed for a number of transitions between levels of spins ½ up to 5½ and levels of spins ½ up to 7½. In each case the entrance channel spin is ½. (auth)

40492 THEORY OF CONVERSION-ELECTRON POLARIZATION CORRELATIONS IN THE CASCADE TRANSITIONS. Boldyshev, V. F. Yadern. Fiz., 6: 24-35(July 1967). (In Russian).

The K-electron polarization correlation is studied in nuclear cascades with photon and conversion transitions. The internal conversion is considered using the Furry-Sommerfield-Maue approximation. The analytic expressions for the correlation functions are obtained which relate the directions of emission and polarization of the electron and the direction of γ-quantum emission. (auth)

40493 DETERMINATION OF MIXING PARAMETER IN NUCLEAR RADIATION TRANSITIONS. Lobov, G. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 6: 36-9(July 1967). (In Russian).

Angular correlations between two linearly polarized cascade photons are calculated for the general case of mixed transitions with arbitrary multipolarity. The expressions obtained for the correlations are suitable for an unambiguous determination of the mixing parameters from the experimental data. The numerical calculation of the angular correlations is fulfilled for the nuclei ^{49}Ti and ^{36}Cl. (auth)

40494 ENERGY OF NUCLEON PAIRS IN LIGHT NUCLEI. Nemirovskii, P. E. Yadern. Fiz., 6: 40-3(July 1967). (In Russian).

Energies of the proton and neutron pairs in nuclei with $8 \leq A \leq 56$ are considered. The wave functions calculated in case of the Woods-Saxon potential are used as well as the pair interaction of the form $c\delta(r-r')$. A reasonable agreement is obtained in 43 cases out of the total number of 53 pairs in view. (auth)

40495 EXCITATION OF VIBRATIONAL LEVELS OF EVEN-EVEN NUCLEI IN ALPHA DECAY. Nosov, V. G. Yadern. Fiz., 6: 44-61(July 1967). (In Russian).

A behavior of the ground-state octupole-deformation amplitude was found according to the α-decay excitation of the negative-parity levels for nuclei with nonspherical equilibrium configuration. The probability was estimated of excitation of the two-phonon octupole level which has not been observed yet. For the quadrupole gamma oscillations, the origin of nonobservations of the corresponding one-phonon level population in alpha decay was established. The probability of this process is calculated. In the region of nuclei with spherical equilibrium configuration, the behavior of the quantum fluctuations of the quadrupole deformation is consistent with the data on the E2-θ transitions between the corresponding vibrational levels. The probability of alpha-particle formation increases by an order at the point of the transition from spherical nuclei into nonspherical nuclei. This fact shows a more essential variation of the nuclear energy spectrum for the corresponding "phase transition" than was previously proposed. A possible behavior is considered of the quantum fluctuations of different nuclear deformations close to the phase transition point. (auth)

40496 DYNAMICAL POLARIZABILITY OF DEUTERON AND ELASTIC SCATTERING OF DEUTERONS ON NUCLEI. Sitenko, A. G.; Levshin, E. B. (Inst. of Physics, Kiev). Yadern. Fiz., 6: 62-5(July 1967). (In Russian).

The isotopic dependence of nucleon optical potentials results in the dynamical polarizability of deuterons in scattering on nuclei. The correction to the plastic scattering amplitude due to the deuteron dynamical polarizability is calculated in the adiabatic approximation. The account of the polarizability affects the character of the angular distribution in the elastic scattering of deuterons and permits the calculated curves to the experimental data. (auth)

40497 GENERAL REGULARITIES IN THE REACTIONS OF SUBSTITUTION OF NUCLEON CLUSTERS IN NUCLEI OF p-SHELL. Zelenskaya, N. S.; Magzumova, V. S.; Neudachin, V. G.; Smirnov, Yu. F.; Teplov, I. B. (Moscow State Univ.). Yadern. Fiz., 6: 66-76(July 1967). (In Russian).

A general consideration of the reactions of substitution of nucleon associations (a triangular graph) in nuclei of the 1p-shell is made using the shell-model reduced widths. The conditions of constructive interference of the reaction amplitudes are formulated approximately in the SU(3) scheme, and it is shown that the character of interference is not directly connected with the type of Young's orbital scheme. Sharp changes in the reaction cross section when passing from one nucleus to another are shown to be mainly due to the statistical factors (which increase strongly when the intermediate nucleus C has no spin) though the character of interference plays a definite role when the number of states of C is large (i. e., the nucleus C is in the center of the p shell). (auth)

40498 TABLES OF THE SU_3 FRACTIONAL-PARENTAGE AND CLEBSCH-GORDAN COEFFICIENTS IN THE 2s-1d SHELL. I. Akiyama, Yoshimi (Tokyo Univ.). Nucl. Data, Sect. A, 2: 403-27(Nov. 1966).

The SU_3 fractional-parentage and Clebsch–Gordan coefficients in the 2s–1d shell were calculated numerically for systems of up to six nucleons. The classification scheme of the states is characterized by the group chain $SU_6 \supset SU_3 \supset R_3$, and the basis functions are represented in a completely orthogonal system. A new reciprocity relation (phase convention) for the Clebsch–Gordan coefficients is proposed and adopted in the tabulation. A table of the coefficients of fractional parentage is presented. A sample of the table of Clebsch–Gordan coefficients is given. The complete table is available from the American Documentation Institute Auxiliary Publications Project. (auth)

40499 INTERPRETATION OF PHOTONUCLEAR ANGULAR DISTRIBUTIONS. Frederick, David E. (Ames Lab., Iowa). Contract W-7405-eng-82. Nucl. Phys., A101: 250-72(1967). (IS-1512).

Photonucleon angular distributions are calculated in the j-j coupling scheme for single-particle excitations. The electromagnetic interaction of the nucleus with the photon beam is treated in electric dipole and quadrupole absorption approximations. The general results allow the extraction of information about the one-particle–one-hole transition strengths from the experimentally measured angular distributions. The importance of the coherent interference terms in the electric dipole cross section is discussed. It is shown that, except in special cases, the amount of electric quadrupole absorption involved in photoproton production can be estimated only to the nearest order of magnitude from the asymmetry about 90° in the angular distribution. The effects of inclusion of the spin-orbit force on the interpretation by Shoda of systematics in 1d-2s shell nuclei are described briefly. (auth)

40500 SUPERFLUIDITY NUCLEAR MODEL AND ODD-MASS NUCLEI. Shaker, M. O.; Kresnin, A. A. (Atomic Energy Establishment, Cairo). Nucl. Phys., A101: 333-7(1967).

A method for calculating the moments of inertia of the odd-mass nuclei within the framework of the superfluidity model is developed. In the adopted method, the odd-mass nucleus is treated as a doubly even, superfluid core plus outside unpaired nucleons. As an example, calculations for ^{25}Al, ^{29}Si, and ^{183}W are performed in detail. It is shown that the adopted method successfully describes the moments of inertia both for the ground and excited states of the odd-mass nuclei. The results obtained show the applicability of the superfluidity model for the investigation of the odd-mass nucleus properties. (auth)

40501 NUCLEAR-SPECTROSCOPY CALCULATIONS INCLUDING CONTINUUM STATES AND APPLICATION TO THE GIANT RESONANCE OF ^{16}O. Raynal, J. (CEN, Saclay, France); Melkanoff, M. A.; Sawada, T. Nucl. Phys., A101: 369-407(1967).

A simple generalization of nuclear-spectroscopy calculations to include continuum states leads to coupled integral equations. The same problem may be treated in nuclear reaction theory by solving coupled differential equations wherein the residual interaction range and total nucleon antisymmetrization introduce integral terms. Both of these approaches were applied to the giant resonance of ^{16}O including only five channels in order to study by what methods and in what limits the coupled integral equations of the first formulation may be utilized. It is shown that the first method may be used in problems for which the number of channels is not too large; it allows analysis of the effects of quasi-bound, two-particle–two-hole states or more complex ones which should explain the fine structure of the giant resonance. (auth)

40502 CORE POLARIZATION AND THE MICROSCOPIC MODEL OF INELASTIC SCATTERING. Love, W. G.; Satchler, G. R. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Nucl. Phys., A101: 424-48(1967). (ORNL-P-3145).

The renormalization of the effective interaction between projectile and valence nucleons of the target due to polarization of the target "core" is calculated using a simple collective model for the core. The core coupling parameters are obtained from the effective charges needed for the observed electromagnetic transition strengths. The model is applied to proton scattering by ^{16}O, ^{90}Zr, ^{92}Zr, and ^{208}Pb. A large part of the observed cross sections is accounted for by the core polarization alone. For example, the strength required for the phenomenological interaction previously introduced is reduced by about a factor of two. An approximate pseudopotential was also deduced from free nucleon-nucleon scattering by using the impulse approximation, but was found to be too weak even with core-polarization effects. (auth)

40503 CHANNEL ANALYSIS OF CROSS SECTIONS AND ANGULAR DISTRIBUTIONS FOR FISSION INDUCED BY NEUTRONS AND PHOTONS. Vandenbosch, R. (Univ. of Washington, Seattle). Contract AT(45-1)-1388. Nucl. Phys., A101: 460-72 (1967). (RLO-1388-19).

Excitation functions and angular distribution data for neutron-induced fission of ^{234}U, ^{236}U, and ^{238}Pu and photofission of ^{238}Pu were analyzed to extract information about the fission barrier. The fission barrier heights and curvatures deduced from the ^{238}Pu photofission data predict a significant contribution of the (n,γf) reaction for low-energy, neutron-induced fission of ^{237}Pu in agreement with a recent measurement. The rapid variation with energy of the fission fragment angular anisotropy for ^{234}U requires an effective fission barrier with a curvature smaller than that given by previous estimates. This may be due to a single-particle effect of the odd nucleon. It is also shown that K-state assignments made in previous analyses of anisotropy measurements are not unique. (auth)

40504 EFFECTIVE CENTRAL INTERACTION FOR NUCLEAR HARTREE–FOCK CALCULATIONS. Saunier, Gerard; Pearson, J. M. (Univ. of Montreal). Phys. Rev., 160: 740-5(Aug. 20, 1967).

Previous successful finite-nucleus Hartree–Fock calculations, such as those of the Baranger group, have required of the effective two-nucleon interaction simply that it correctly saturate nuclear matter in first-order perturbation theory, with the second-order correction being small. In an attempt to relate the effective central interaction to the real nucleon–nucleon force, the spirit of the separation method was followed with the condition that the two be identical in the long-range region. As for the short-range region, it is argued that the considerable uncertainty in this part of the real force does not justify the application of a reaction-matrix theory which itself is not completely unequivocal in this region. Instead, the short-range part of the interaction is purely phenomenological, determined by still requiring that the total interaction satisfy the nuclear-matter condition, a condition which in any case appears from the work of Bhaduri and Tomusiak to be necessary for correct results in finite nuclei. The role in finite-nucleus Hartree–Fock calculations of different effective interactions is then investigated by calculating the binding energy and rms radius of ^{16}O and ^{40}Ca in the well-tested approximation of their wave functions being pure oscillator in form. It is found that interactions that give identical saturation of nuclear matter are not necessarily completely equivalent in finite nuclei. However, requiring that the effective interaction conform in the long-range region to the real force leads to finite-nucleus results that are just as acceptable as those given by phenomenological interactions fitted to the same nuclear-matter saturation point but bearing no apparent relation to the real force. (auth)

40505 SHELL-MODEL CALCULATIONS FOR N = 30 NUCLEI. McGrory, J. B. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Rev., 160: 915-24(Aug. 20, 1967). (ORNL-P-2907).

The results of shell-model calculations on N = 30 nuclei with $20 \leq Z \leq 27$ are reported. An inert ^{48}Ca core is assumed, protons are restricted to the $1f_{\frac{7}{2}}$ shell, and the two active neutrons can occupy the $2p_{\frac{3}{2}}$, $2p_{\frac{1}{2}}$, and $1f_{\frac{5}{2}}$ orbits. A Hamiltonian is used which leads to a good fit to selected experimental data in this same mass region. For all nuclei treated here except ^{57}Co, the agreement of the calculated spectra with experimental spectra for states below an excitation energy of about 2.5 MeV is satisfactory. The shell-model wave functions are used to calculate spectroscopic factors for one- and two-nucleon transfer reactions which involve ^{54}Cr, ^{55}Mn, and ^{56}Fe. The qualitative results for the one-nucleon transfer reactions are in satisfactory agreement with the factors extracted from experimental data. The predicted relative strengths for strong transitions in these reactions are not in good agreement with the extracted numbers. The quantitative agreement between the predicted strengths and the strengths extracted from experiment for the ^{54}Fe(t,p)^{56}Fe reaction is good. (auth)

40506 SHELL MODEL OF THE NICKEL ISOTOPES. Cohen, S.; Lawson, R. D.; Macfarlane, M. H.; Pandya, S. P.; Soga, Michitoshi (Argonne National Lab., Ill.). Phys. Rev., 160: 903-15(Aug. 20, 1967).

The isotopes of nickel are described by a shell model within the identical-nucleon configurations $(2p_{\frac{3}{2}}, 1f_{\frac{5}{2}}, 2p_{\frac{1}{2}})^n$. A least-squares fit to observed level energies yields an effective interaction which satisfactorily reproduces the level structure of the Ni isotopes from ^{58}Ni to ^{66}Ni. This best-fit interaction is shown to indicate repulsive interactions between identical-nucleon shells and to conserve seniority to a useful degree of approximation. The interaction matrix elements are in fair agreement with those of an approximate reaction matrix computed by Kuo from Hamada and Johnston's free-nucleon interaction, this agreement being obtained only when core polarization is taken into account. Moments and transitions also show the strong influence of core excitation. Observed quadrupole moments and E2 transition rates are adequately reproduced with an effective neutron charge of between 1.5e and 2e; in particular, the observed inhibition of the crossover ground-state decay of the second $2^+(2_2^+)$ states of ^{60}Ni and ^{62}Ni is reproduced with 2_2^+ wave functions for which a two-phonon vibrational

description is clearly incorrect. It is shown that the original model cannot account for the large deviations of observed magnetic moments from the Schmidt values, nor for the observed spreading of stripping strength into a given orbit over several states of the residual nucleus. To account for these, it is necessary to introduce effective transition operators, strongly modified by the influence of neglected configurations. (auth)

40507 (^{3}He,pp) REACTION. Henley, E. M.; Lacy, C. E. (Univ. of Washington, Seattle). Contract AT(45-1)-1388. Phys. Rev., 160: 835-45(Aug. 20, 1967). (RLO-1388B-510).

The (^{3}He,pp) stripping reaction is studied in the distorted-wave Born approximation, with simplifying assumptions which allow a two-body formulation of the problem. Two limiting cases are investigated. (1) The emerging protons are closely correlated; their final-state interaction with each other is treated appropriately, but those with the nucleus are approximated by one with the center of mass of the pair. (2) The protons interact individually with the residual nucleus but their mutual interaction is neglected. It is found that for a given relative momentum q of the two protons the angular distribution for the recoiling residual nucleus is essentially the same for the two cases. However, the differential cross section depends only on the magnitude of q in case (1), whereas it depends on both the magnitude and direction of q for case (2). Thus, an experimental distinction between the limiting cases should be possible. (auth)

40508 THREE-BODY CALCULATIONS FOR $_\Lambda$Be^9 WITH SEPARABLE POTENTIALS. Monga, S. K. (Univ. of Delhi). Phys. Rev., 160: 846-52(Aug. 20, 1967).

The $_\Lambda$Be^9 hypernucleus regarded as a three-body bound state is investigated with separable potentials between the α-Λ pair and the α-α pair (without the Coulomb interaction). The energy eigenvalue is found to be consistent with the magnitudes of the force parameters obtained by fits to the α-Λ and α-α data. As one of the applications of the exact three-body wave functions obtained by solving the three-body Schroedinger equation numerically, a perturbative calculation of the Coulomb energy of $_\Lambda$Be^9 gives a reasonable estimate of ~3 MeV. The results of this three-body approach to the $_\Lambda$Be^9 system are discussed in relation to those of contemporary variational calculations. (auth)

40509 SOLUTION OF COUPLED EQUATIONS BY R-MATRIX TECHNIQUES. Buttle, P. J. A. (Florida State Univ., Tallahassee). Phys. Rev., 160: 719-29(Aug. 20, 1967).

A realistic coupled-equation problem is solved using various R-matrix and level-matrix techniques. Comparison with exact coupled-equation calculations shows that excellent numerical results are possible with these methods, both in resonant and in nonresonant energy regions. The effects of varying the R-matrix boundary conditions and the number of levels included in the calculation are considered. Various aspects of R-matrix theory, such as the composition of R-matrix states, and the interference between neighboring levels, are illustrated by the calculations. (auth)

40510 FINE STRUCTURE IN NUCLEAR RESONANCES. MacDonald, W.; Mekjian, A. (Univ. of Maryland, College Park). Contract AT(40-1)-3491. Phys. Rev., 160: 730-9(Aug. 20, 1967).

A K-matrix formulation is given for the shell-model approach to a unified reaction theory. This K matrix differs from the R matrix of Wigner and Eisenbud in using distorted waves of a diffuse potential. The penetrabilities and channel phase shifts are therefore those for a diffuse potential rather than those for a square well with hard-sphere boundary conditions at some radius. This K matrix is used to discuss the fine structure produced by a doorway-hallway system, and a result obtained earlier by Ferrell and MacDonald is rederived. A resonance expansion is then found which explicitly exhibits the widths and resonance energies in a multilevel formula. The distribution of the widths is found, a sum rule is derived, and the average cross section is derived. A general resonance formula is then derived for the case of any number of hallway and doorway states. This is used to generalize the previously obtained doorway-hallway results to the case of hallways coupled to the continuum. In certain cases, a characteristic asymmetry is shown to result. (auth)

40511 UNRESTRICTED HARTREE-FOCK TREATMENT OF FINITE NUCLEI. Bassichis, W. H.; Kerman, A. K.; Svenne, J. P. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev., 160: 746-52(Aug. 20, 1967). (MIT-2098-316).

A smooth, nonlocal interaction which fits two-body scattering data reasonably well is used in a Hartree-Fock calculation of the binding energies and quadrupole moments of the even-even nuclei with A between 4 and 40. The calculation is unrestricted in that the orbitals of all the particles are determined self-consistently with both radial and angular variations allowed. For the deformed nuclei, a naive rotational correction is made to allow comparison with experiment. The second-order term is computed in a perturbation expansion for which the Hartree-Fock result is the first-order term. The perturbation series apparently converges, and the results to second order agree quite well with experiment. The single-particle energies of the various nuclei are calculated in first and second order with polarization taken into account. Finally, the symmetry energy is studied in the A = 48 system. (auth)

40512 FINITE-RANGE EFFECTS IN THE DISTORTED-WAVE IMPULSE APPROXIMATION. Haybron, R. M. (Oak Ridge National Lab., Tenn.). Phys. Rev., 160: 756-68(Aug. 20, 1967). (ORNL-P-2921).

The usual (zero-range) distorted-wave, impulse approximation applied to the inelastic scattering of high-energy protons by nuclei ignores the averaging of the two-nucleon t matrix over the range of momentum transfers introduced by the distorted waves. The effects of including this averaging (the finite-range calculation) are investigated at 50, 100, and 150 MeV for quadrupole transitions in ^{12}C and ^{40}Ca using a much simplified form of the two-nucleon t matrix. It is found that the finite-range effects are not negligible even at the highest energy; in particular, the 150-MeV cross section for ^{12}C is reduced by a factor of two in the forward direction, while the peak cross section for ^{40}Ca is reduced by 20% at this energy. An attempt is also made to fit the data on the 2^+ level of ^{12}C at 45.5 MeV using the finite-range calculation, and it is found that the strength of the transition predicted by the impulse approximation (using the simplified t matrix) is too small by a factor of more than three. Exchange effects were ignored in the finite-range calculations. (auth)

40513 DETERMINATION OF NUCLEAR ROTATIONAL PARAMETERS. Kelson, I. (Yale Univ., New Haven). Phys. Rev., 160: 775-82(Aug. 20, 1967).

The methods of extracting nuclear rotational parameters are critically reviewed. An external consistency condition is proposed as a necessary condition for the validity of such methods. (auth)

40514 THEORY OF PARTIALLY CONSERVED AXIAL-VECTOR CURRENT AND MESONIC EXCHANGE EFFECTS IN NUCLEAR BETA DECAY. Blin-Stoyle, R. J.; Tint, Myo (Univ. of Sussex, Eng.). Phys. Rev., 160: 803-8(Aug. 20, 1967).

By assuming that the axial-vector current is partially conserved, a relationship is obtained between the phenomenological meson-exchange operator in beta decay and the two-body pion-production operator. An analysis of the experimental results for the process $p + p \rightarrow d + \pi^+$ in terms of this operator is made, and the strength of the meson-exchange operator is then deduced from the relationship. It is found that the strength does not agree with that necessary to account for the ft value of the beta-decay process $^3H \rightarrow {}^3He + e^- + \bar{\nu}$. Possible reasons for the disagreement are discussed. (auth)

40515 UNIFIED THEORY OF NUCLEAR MODELS AND FORCES. Brown, G. E. New York, John Wiley and Sons, Inc., 1967. 269p.

A unified description of nuclear models is presented. The shell model, the collective model, and the optical model are all discussed. Vibrational motion and pairing are treated in detail. The description is based on the time-independent and time-dependent Hartree-Fock theories with emphasis on the common basis of the models in these theories. (S.F.L.)

40516 EFFECT OF THE TWO-PARTICLE SPIN-ORBIT NUCLEON-NUCLEON INTERACTION ON THE ^{16}O AND ^{16}N NUCLEI. Coulter, Byron Leonard. University, Ala., Univ. of Alabama, 1966. 82p.

Thesis.

The odd-parity states of ^{16}O and ^{16}N nuclei are assumed to be described by a hole in a 0p state and a particle in a 1s or 0d state moving in a harmonic-oscillator potential well. Degeneracies in the energy eigenvalues are removed by a particle-hole interaction consisting of a two-particle central scalar interaction potential with a Serber exchange mixture and a two-particle spin-orbit vector interaction potential. A comparison of theoretical energy level, beta-decay, and muon-capture calculations with experimental data indicates that the two-particle spin-orbit potential exerts a significant influence on some properties of the ^{16}O and ^{16}N nuclei. Its use produces an improved theoretical prediction of virtually every feature considered, and, in particular, reasonable predictions of the $2^- \rightarrow 1^-$ beta decay and the $0^+ \rightarrow 1^-$ muon capture were unattainable without the use of the spin-orbit interaction between the particle and hole states. (Disser. Abstr.)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 38944, 38946, 39114, 39197, 39574, 39577, 39581, 39582, 39601, 40350, 40665, and 40694.

40517 (ACNP-66513) LA CROSSE BOILING WATER REACTOR. REACTOR VESSEL MATERIAL SURVEILLANCE PROGRAM FOR EVALUATION OF RADIATION EFFECTS. (Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.). Feb. 1966. 83p. Dep. CFSTI.

Radiation damage studies on the LACBWR reactor vessel materials are presented. Fast neutron damage to ferritic steel is discussed; results from surveillance test specimens are given. (M.L.S.)

40518 (AE-285) POWER DISTURBANCES CLOSE TO HYDRODYNAMIC INSTABILITY IN NATURAL CIRCULATION TWO-PHASE FLOW. Mathisen, R. P.; Eklind, O. (Aktiebolaget Atomenergi, Stockholm (Sweden)). July 1967. 32p. Dep. SWED.

In certain boiling reactor designs high positive void coefficients could exist and under certain circumstances cause instability. Control systems may therefore be desired. In such a controlled reactor there could remain superimposed low frequency power oscillations of some magnitude. Experiments in SKALVAN to examine whether or not such slow oscillations could influence the hydrodynamic stability limit of the individual boiling channels were performed. While operating the loop close to the threshold of hydrodynamic instability, the power was pulsed in the boiling channel. The pulse widths had a lower limit of 0.65 sec due to the contactor time constant. The square wave power oscillation amplitude ($\Delta Q/\bar{Q}$) was 12.2%, and the interval T between the pulses was varied in the range $0 < (T_0/T) < 0.5$ where T_0 was the mass flow oscillation period. The corresponding mass flow oscillations remained damped for all disturbance periods which were examined. With minimum test section inlet restrictions the power level at instability was much lower than that at burnout conditions. At higher restrictions these phenomena occurred at approximately equivalent power levels. The experiments with minimum inlet restrictions were also performed beyond the instability threshold. In this case it was possible to exceed the nominal burnout point temporarily by 5 per cent or more for periods of the order of magnitude 1 second. Even now the boiling channel conditions were not so severely affected that the burn-out detectors tripped, and the power disturbances caused low frequency modulated wave trains. (auth)

40519 (AE-289) MEASUREMENTS OF THE REACTIVITY PROPERTIES OF THE AGESTA NUCLEAR POWER REACTOR AT ZERO POWER. Bernander, G. (Aktiebolaget Atomenergi, Stockholm (Sweden)). July 1967. 43p. Dep. SWED.

The moderator level and temperature coefficients of reactivity and control rod differential reactivity worths have been determined at zero power by means of period measurements. The moderator level coefficient and the corresponding critical level have been measured for the 32, 68 and 136 fuel assembly cores at room temperature for cores with and without control rods. From these results the worths of control rods have been derived. HETERO calculations give up to 15% lower values than the experimental results. The cold fresh core has an excess reactivity of 9.0 ± 2%. The temperature coefficient and differential control rod worths were measured for the fully loaded core with filled tank in the temperature range between 30 and 210°C. Critical positions as a function of temperature were obtained for the corresponding control rod groups. No relevant calculations of the temperature coefficient for comparison with the experimental values have yet been made, but the experimental results together with measured critical control rod positions give good opportunities to check calculational programs. HETERO has been shown in these cases to reproduce differential control rod worths and critical positions fairly well. However, a certain underestimation of the rod effectiveness is quite noticeable. The relative increase in control rod effectiveness with a temperature change from 20 to 220°C has been estimated to be 0.29 ± 0.06. (auth)

40520 (AECL-2827) HEAVY WATER POWER REACTORS. Millar, C. H. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Nov, 1966. 25p. Dep. CFSTI. CAN $1.00.

The unique properties of D_2O as a neutron moderator and the attendant advantages of heavy water power reactors are reviewed. The characteristics and special features of the various members of this reactor family are discussed and compared, the reactors being classified principally by the nature of the coolant. The history of heavy water reactor development is reviewed briefly, the status of the different "demonstration" reactors is noted, and a listing of full scale power reactors under construction is given. Current areas of research and development are outlined, together with predictions of possible future developments. (auth)

40521 (AEEW-M-754) THE ROLE OF DIGITAL COMPUTERS IN THE PHYSICS ASPECTS OF THE DESIGN OF GAS-COOLED GRAPHITE-MODERATED REACTORS. Tyror, J. G. (Atomic Energy Establishment, Winfrith (England)). May 1967. 14p. (CONF-670501-13). Dep. CFSTI. UK.

From International Conference on Research Reactor Utilization and Reactor Mathematics, Mexico City, Mex.

The developing use of digital computers in evaluating the physics aspects of graphite-moderated reactor design is discussed. Three broad categories of physics computation are the detailed and sophisticated computation which provides absolute results to check the validity of more approximate but quicker methods, the highly idealised calculation in which simplification has been sought since the physics calculation is but one part of some overall design computation, and core performance evaluations in which adequate accuracy is sought but with methods which are rapid and therefore allow many design variations to be studied. Physics computations for AGR, in particular fuel management calculations, are described. (UK)

40522 (AEEW-R-524) HAMBO: A COMPUTER PROGRAMME FOR THE SUBCHANNEL ANALYSIS OF THE HYDRAULIC AND BURNOUT CHARACTERISTICS OF ROD-CLUSTERS. PART I. GENERAL DESCRIPTION. Bowring, R. W. (Atomic Energy Establishment, Winfrith (England)). Apr. 1967. 24p. Dep. CFSTI. UK 4s. 0d.

HAMBO is a computer code for the steady-state hydraulic analysis of a rod-cluster assembly cooled by a boiling fluid, using a subchannel model. The cluster burnout power is assessed by means of a subchannel burnout correlation. Clusters which can be represented with 10 subchannels, i.e., with up to 37 rods in a cylindrical pressure tube, can be analyzed with the present version of the program. The code is a design tool for the thermal performance assessment of fuel assemblies in nuclear reactors cooled by water-steam mixtures. It can be used to determine the effect of change in cluster radial flux depression, rod pitch, bowing and eccentricity on the fluid density and burnout power. The hydraulic model includes: heat and momentum transfer between adjacent coolant subchannels by mass transfer (cross-flow) and by turbulent mixing; single phase, subcooled boiling and bulk boiling regimes; rod spacing by localized grids or by wire wraps; radial and axial heat profile; and lateral resistance to cross-flow. The code is written in Egtran dialect of FORTRAN for the KDF 9 computer and is being translated into FORTRAN S2 and IV for the IBM 7030 and 7090 machines respectively. Typical running times per case are from 15 seconds for a 7-rod cluster to 150 seconds for a 37-rod cluster. (auth)

40523 (AHSB(S)R-127) AHSB REPORTING SYSTEM FOR PLANT FAULTS-PLANT FAULT CODE. Parker, E.; Roughley, R. (United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch). 1967. 51p. Dep. CFSTI. UK

This Plant Fault Code is for use in conjunction with a punch card system for the recording and storage, in the Authority Health and Safety Branch, of details of faults and incidents that occur on U.K.A.E.A. plants and nuclear reactors. Fault statistics from sources other than the U.K.A.E.A. may be included when available. (auth)

40524 (AI-CE-44) HEAVY WATER ORGANIC COOLED REACTOR. DESIGN, FABRICATION, AND INITIAL OPERATION OF EXP-WR1-951 FUEL STRING. Lillie, A. F. (Atomics International, Canoga Park, Calif. Combustion Engineering, Inc., Windsor, Conn.). Aug. 31, 1967. Contract AT(38-1)-430. 48p. Dep. CFSTI.

The EXP-WR1-951 fuel string is the first in a series of SAP clad-hyper UC irradiation tests to be performed by the HWOCR program in the WR-1 reactor. The design, analysis and fabrication of the test assembly are described. The initial operating performance is discussed. Comparison of these data with design conditions indicates that test performance is well within design margins. (auth)

40525 (ANL-7290) REACTOR ENGINEERING DIVISION ANNUAL REPORT, JULY 1, 1965-JUNE 30, 1966. (Argonne National Lab., Ill.). Apr. 1967. Contract W-31-109-eng-38. 234p. Dep. CFSTI.

The Argonne National Laboratory Reactor Engineering Division annual report contains the following sections: Experimental Breeder Reactor-II, the Argonne Advanced Research Reactor, the Experimental Boiling Water Reactor, the Argonne Nuclear Rocket Program, Fast Reactor Research and Development, Liquid Metal Heat Transfer Research Program, Magnetohydrodynamics, Reactor Safety Research and Development, and a Feasibility Study of a Nuclear Steam Supply System using a 10,000 MW Sodium-Cooled Fast Breeder Reactor. Separate abstracts have been prepared for each section. (M.L.S.)

For abstracts of individual sections see: 40526–40532, 40651, and 40669.

40526 (ANL–7290, pp 9-27) EXPERIMENTAL BREEDER REACTOR-II (EBR-II). (Argonne National Lab., Ill.).

Modifications of the Experimental Breeder Reactor-II are discussed. The facilities modified are the main primary system pump covers, sodium surveillance periscope, subassembly transfer arm, spent fuel element subassembly monitor, core subassembly blanket sections, control rod drive mechanisms, and digital control. Fuel element subassemblies design for the EBR-II are given. Out-of-pile testing of fabricated subassemblies is discussed briefly. Control and instrumentation design modifications are outlined. (M.L.S.)

40527 (ANL–7290, pp 119-23) EXPERIMENTAL BOILING WATER REACTOR (EBWR). (Argonne National Lab., Ill.).

Modifications of the EBWR are discussed. These modifications included system piping, welds, valving, and feedwater full-flow filters. A summary of cold-critical experiments, made on the Pu-fueled core, is given. Zero-power transfer function measurements are discussed briefly. (M.L.S.)

40528 (ANL–7290, pp 139-69) FAST REACTOR RESEARCH AND DEVELOPMENT. (Argonne National Lab., Ill.).

The design parameters for a 1000 MW(e) metal fueled fast breeder reactor are given. Equilibrium fuel cycle costs for metallic fueled systems are tabulated. The design and economic study of Na-heated steam and turbine generator islands for 500 MW and 1000 MW stations is summarised. Capital costs of turbine-generator islands is related to steam conditions. The 1000 MW(e) Fast Breeder Reactor program is evaluated. A general description of the 1200°F Component and Materials Evaluation Loop is given. Materials evaluation of the High-Temperature Sodium Long-Term Environmental Test Loop is summarised. Tests conducted in the Material Compatibility Test Facility is described. The modified Falex Machine for high-temperature Na wear tests is described; the operational procedures are outlined. A 1200°F Na furnace-tensile testing machine is described. Techniques for Na quality control are outlined. In-core instrumentation, including thermocouples and electromagnetic flowmeters, is described. (M.L.S.)

40529 (ANL–7290, pp 170-7) LIQUID METAL HEAT TRANSFER RESEARCH PROGRAM. (Argonne National Lab., Ill.).

The liquid metal heat transfer research program is discussed. Work done on boiling sodium studies and evaluation of traditional liquid metal heat transfer design computations are outlined. An electron bombardment heater, being developed to replace the thermal radiation heater, is discussed; important characteristics are presented. Heat transfer calculations for double-pipe heat exchangers are discussed in some detail. (M.L.S.)

40530 (ANL–7290, pp 178-87) MAGNETOHYDRODYNAMICS. (Argonne National Lab., Ill.).

Studies on coupled reactor–liquid metal magnetohydrodynamic energy conversion cycles for commercial and space power applications are discussed. Generator concepts are outlined; test models, procedures, and results of tests are evaluated. Reduction of end losses in MHD channels is discussed. Materials constraints on a-c induction MHD generators are summarized. (M.L.S.)

40531 (ANL–7290, pp 188-215) FAST REACTOR SAFETY RESEARCH AND DEVELOPMENT. (Argonne National Lab., Ill.).

A brief description, with sample data, of an analytical model for predicting incipient boiling superheats in liquid metals is given. Na expulsion studies are outlined. Analytical and experimental studies of critical flow steam-water mixtures, sodium, and water are discussed. A single fixed-position detector system for the continuous monitoring of ten decades of neutron flux is described. Space-time dependent reactor dynamics studies are summarized. Synthesis of an optimal control system for reactors with generalized temperature feedback is discussed. Experimental facilities for fuel meltdown studies are described. Containment systems studies are outlined. 25 references. (M.L.S.)

40532 (ANL–7290, pp 216-26) FEASIBILITY STUDY OF A NUCLEAR STEAM SUPPLY SYSTEM USING A 10,000-MW SODIUM-COOLED FAST BREEDER REACTOR. (Argonne National Lab., Ill.).

Design parameters for a 10,000 MW(t) sodium-cooled fast breeder power plant are tabulated. A description of the conceptual design is given. Cost factors are outlined. (M.L.S.)

40533 (ANL–7326) RABBLE: A PROGRAM FOR COMPUTATION OF RESONANCE ABSORPTION IN MULTIREGION REACTOR CELLS. Kier, P. H.; Robba, A. A. (Argonne National Lab., Ill.). Apr. 1967. Contract W-31-109-eng-38. 44p. Dep. CFSTI.

A method of computing resonance absorption in either slab or circularized reactor cells is developed and used to write a FORTRAN program, RABBLE, for the CDC-3600. Since the method uses space- and lethargy-dependent slowing-down sources, the program is well suited for the computation of resonance absorption when the effects of overlapping between resonances is significant. The cell is divided into regions, and the energy range of interest is divided into extremely narrow groups. Regional reaction rates are obtained from the slowing-down sources, first-flight transmission and escape probabilities, and interface currents. These regional reaction rates are accumulated over specified numbers of groups to yield effective cross sections. RABBLE allows for five compositions, which can be divided into 20 regions. There can be 12 nuclides, all of which can be resonant absorbers. The sum of the resonances is limited to 800. Effective cross sections and average fluxes are edited for up to 1000 intermediate groups and 25 broad groups. The number of fine groups per intermediate group and the number of intermediate groups per broad group are broad-group dependent. (auth)

40534 (ANL–7349) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JUNE 1967. (Argonne National Lab., Ill.). July 31, 1967. Contract W-31-109-eng-38. 140p. Dep. CFSTI.

Presented are items of significant technical progress which have occurred in specific reactor projects and in general engineering research and development programs. Individual sections are: Plutonium Utilization: EBWR, Liquid-Metal Fast Breeder Reactors, General Reactor Technology, Advanced Systems Research and Development, and Nuclear Safety. Separate abstracts were prepared for each of the five sections. (H.D.R.)

For abstracts of individual sections see: 40535–40537, 40670, and 40694.

40535 (ANL–7349, pp 1) PLUTONIUM UTILIZATION: EBWR. (Argonne National Lab., Ill.).

The Experimental Boiling Water Reactor facility continued operation through the end of June. Since the Plutonium Recycle Program is being terminated, power operation was scheduled to end on June 29. Preparations are being made for gathering final critical data, core unloading, and plant layup. (H.D.R.)

40536 (ANL–7349, pp 2-91) LIQUID-METAL FAST BREEDER REACTORS. (Argonne National Lab., Ill.).

The plan of action to locate the source of the fission gas release in EBR-II was approved. Operation of the reactor in accordance with this plan was begun immediately. A fission gas release was obtained at 30 MW, and the reactor was shut down and a program of analyses of the specific components of the released fission products was again started. In a subsequent repeat of a fission gas release test, a release was obtained at 10 MW. The three most suspect experimental irradiation subassemblies, XG05, XA08, and XO11, were then removed from the reactor and operation restarted. After 150 MW-days of operation with no evidence of fission gas release, the reactor was shut down and Subassembly XO11 reinserted. After startup and at 7.5-MW power level, a fission gas release occurred. XO11 was removed from the core, and XA08 and XG05 were reinserted. The reactor was then started up for a scheduled 150 MW-days of operation at 30 MW or until a fission gas release occurred. No release had been observed by month's end. Normal EBR-II driver fuel production activities at the Fuel Cycle Facility were continued. Thirteen alloy preparation runs were made with unirradiated material to supplement the irradiated fuel inventory. A total of 18 subassemblies were fabricated during the month. Work on the cold line for the fabrication of supplemental driver fuel is proceeding on schedule. The vertical assembly and disassembly machine (VAD) designed for installation in the Air Cell of the Fuel Cycle Facility was received in Idaho, set up and tested in the mockup area, and used for training of its future operators during this month. Installation of the VAD in the Air Cell is scheduled for July. Experiments with Assembly 49 were completed and the approach to critical of Assembly 50 was in progress in ZPR-30. The aim of the experimental program with each assembly is to provide an integral set of data with which the accuracy of existing cross-section sets and analytical techniques can be checked. Some of the results of the analyses of data taken on Assembly 48B are reported. Sodium removal coefficients and

central fission ratios for various isotopes are given. Construction activities of the ZPPR facility were concentrated on the cell ring beam and fill. The status of reactor and facility components is also reported. (auth)

40537 (ANL-7349, pp 115-33) NUCLEAR SAFETY. (Argonne National Lab., Ill.).

The Fuel Element Deformation Module for use in reactor accident analysis was partially programmed, and calculations on the behavior of fluids in the thermodynamic critical region were performed using the lattice gas model of the critical point. Investigations were continued on the basic processes controlling the two-phase critical flow of Na, using steam-water as the working media. The dependence of exit and receiver pressures in two-phase critical flow was measured on three test sections with different downstream geometry. The unbonded EBR-II fuel pin run in flowing Na in the Mark-I integral TREAT loop was removed and examined. The cladding showed no evidence of damage, but the fuel pin sustained severe damage with evidence that melting had occurred. Nineteen stainless steel jacketed $(U,Pu)O_2$ pellet-fueled elements were fabricated for irradiation in EBR-II followed by destructive testing in TREAT. The high-temperature behavior of Zircaloy-2-clad, UO_2-core fuel rods during a reactor transient was studied using sintered-pellet fuel rods submerged in water within a transparent capsule in TREAT. The conditions and results of the three meltdown experiments are summarized. Studies were continued to determine the efficiency with which sorbents can remove low concentrations of TeF_6 from air streams. (H.D.R.)

40538 (APDA-202) COMPUTERIZED SYSTEM OF PROGRAMS FOR FUEL ACCOUNTABILITY AT ENRICO FERMI ATOMIC POWER PLANT. Friedman, M. A.; Volk, E. R.; Maene, N. G. A.; Segal, B. M. (Atomic Power Development Associates, Inc., Detroit, Mich.). May 1967. 87p. Dep.

Computerized records are maintained by subassembly numbers for all core, blanket, and test subassemblies. Data include subassembly location, the original and current isotopic masses, and the maximum to average concentration ratio for each isotope (^{235}U, ^{236}U, ^{238}U, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu). Values for the fuel and axial blanket sections of core assemblies are presented separately. Also included in the computer output are the maximum and average accumulated burnup for each subassembly. The computerized system of programs works in conjunction with the CRAMF multigroup diffusion code. An XY- and RZ-multigroup CRAMF run is made and each is followed by an output processor. The XY Processor produces, for each lattice position, the weighted one-group midplane average and maximum fluxes and cross sections. The RZ Processor determines the axial average to midplane ratios of the fluxes and cross sections necessary to adjust the XY Processor values for axial variation. The fluxes and cross sections from the XY Processor and the axial average to midplane ratios from the RZ Processor are combined by the PHIXUP program to produce the full-lattice set of one-group, axially adjusted fluxes and cross sections. Since, at present, the XY-run is made in quarter symmetry, this program expands the system into the full lattice. The FERMUP program calculates burnup and processes the subassembly data using as input: (1) the fluxes and cross sections from PHIXUP, (2) the subassembly lattice position changes from the reactor load sheets, (3) "swop" data from physics considerations of core and blanket changes, and (4) the integrated power from the reactor operating record. The subassembly data are initially prepared by the CSD program and thereafter are produced by the FERMUP code. The solution of the burnup equations utilizes a truncated infinite series to assure accuracy for both long and short intervals. The processor programs are in Fortran II while all other programs are in Fortran IV. The system runs on the IBM 7094 and requires about 4 minutes to process 800 subassemblies through the FERMUP phase. (auth)

40539 (BMI-1807) NURLOC-1,0: A DIGITAL COMPUTER PROGRAM FOR THERMAL ANALYSIS OF A NUCLEAR-REACTOR LOSS-OF-COOLANT ACCIDENT. Walters, Craig T.; Genco, Joseph M. (Battelle Memorial Inst., Columbus, Ohio). July 6, 1967. Contract W-7405-eng-92. 324p. Dep. CFSTI.

NURLOC-1.0 contains mathematical models for most of the processes occurring in a reactor accident which affect the solid and fluid temperature distributions. Models were developed and programmed for heat conduction, heat generation, thermal radiation, boil-off, meltdown, postblowdown heat and mass transfer coefficients, and metal-water reaction. Test cases of accident heat transfer in the LOFT reactor were calculated for times up to 400 sec. Calculations were also performed for a typical 600-MW(t) BWR for a similar period of time. A typical 1000-MW(e) BWR gave temperature and metal-water reactions much different from those for LOFT; the percentage of cladding reacted was less by more than a factor of two for the 1000-MW(e) reactor than for LOFT for similar periods of time. A CDC-3400 Fortran listing, loading procedure, and flow diagram for NURLOC-1.0 are presented. Detailed definitions of the input variables and their card formats are given. An input data listing for a sample problem and corresponding printed output are presented to serve as an input preparation guide and checkout tool for operation on other computers. 61 references. (auth)

40540 (BMI-X-10202) FISSION-PRODUCT DEPOSITION AND ITS ENHANCEMENT UNDER REACTOR ACCIDENT CONDITIONS. Quarterly Progress Report, April-June 1967. Genco Joseph M.; Berry, David A.; Berry, Warren E.; Rosenberg, Harvey S.; Cremeans, George E.; Price, Robert B.; Morrison, David L. (Battelle Memorial Inst., Columbus, Ohio). July 1, 1967. Contract W-7405-eng-92. 54p. (EURAEC-1904). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Studies conducted on the primary systems of reactors include: low-velocity I_2 deposition experiments with prefilmed Zircaloy-4 plates of 6 weeks in water at 290°C and pH 10 (NH_3); and deposition of HI steam at 150 and 250°C on prefilmed Zircaloy-4 (ZrO_{2-x}) and 304 stainless steel. Studies conducted on the containment systems of reactors include: an analytical model development to explain the sorption-desorption kinetics of I_2 on painted surfaces; liquid-phase deposition of I_2 on containment-systems coatings; and effect of temperature and I_2 concentration on deposition of I_2 on type 304 stainless steel. The experimental apparatus and results of elemental gas phase iodine deposition of methyl iodide on surface materials of primary and containment vessels are presented. Methods for tagging iodine compounds with ^{131}I are described. The reactions of selected phosphine and amine compounds with methyl iodide at 20°C are presented. The sorption characteristics of 11 coatings are presented for methyl iodide in steam at 115 to 170°C. (D.C.C.)

40541 (BNWL-492) ENGINEERING DEVELOPMENT DEPARTMENT QUARTERLY REPORT, JULY-SEPTEMBER 1966. Harty, H.; Batch, J. M.; Pedersen, L. T.; Wheeler, R. G.; Fox, J. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1967. Contract AT(45-1)-1830. 31p. Dep. CFSTI.

FAST TEST REACTOR — fuels for, heat transfer analyses for cermet; fuel elements for, gas cooling of; fuel elements for, temperature of pin segmenting spacers for
REACTOR FUEL ELEMENTS — heat transfer analysis of cermet-type FTR; gas cooling during inspection of; pin segmenting spacers for FFTF, thermal contact coefficients for; coolant in channels of, calculation of interchannel flow effects on; heat transfer of Phoenix, transient; burnout heat flux in, measurements of; testing of FERTF basket-type
HEAT TRANSFER — calculations for FTR cermet fuels
PRESSURE VESSELS — mechanical and hydraulics characteristics of reactor, mockup facility for measurement of
HYDRAULICS — facility for testing reactor pressure vessel, design parameters for
ZIRCONIUM ALLOYS — Nb-Zr-base, pressure tubing of, metallurgical analyses of
NIOBIUM ALLOYS — Nb-Zr-base, pressure tubing of, metallurgical analyses of
PLUTONIUM RECYCLE CRITICAL FACILITY — fuel plates for effects of fabrication on
REACTORS, BOILING — fuels for, calculations for use of plutonia-urania
REACTORS: WATER-MODERATED — fuels for, calculations for use of plutonia-urania
REACTORS, WATER-MODERATED — fuels for, calculations for use of plutonia-urania
REACTORS, PRESSURIZED-WATER — fuels for, calculations for use of plutonia-urania
PLUTONIUM RECYCLE TEST REACTOR — modifications for
CONTAINMENT SYSTEMS EXPERIMENT — iodine deposition studies in; xenon diffusion measurements in
IODINE — deposition studies in CSF; formation in steam condensate; interaction with paint, analysis of
FISSION PRODUCTS — transport of, mathematical model for
URANIUM — analysis of, use of fibrous filters for
COATINGS — behavior of, effects of steam on
DECONTAMINATION — procedures for painted surfaces, evaluation of
XENON — diffusion in CSE, measurements on
ARMY REACTORS (SM-2) — pressure vessel for, blowdown experiments on simulated
REACTOR SAFETY — blowdown analyses for (M.L.S.)

40542 (BNWL-CC-1099) COMPARISON OF METHODS FOR OBTAINING DANCOFF CORRECTIONS. Simmons, G. L.; Purcell, W. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 20, 1967. Contract AT(45-1)-1830. 20p. Dep. CFSTI.

Dancoff corrections obtained by the original Dancoff–Ginsburg computational methods are compared to those obtained by substituting an approximating formulation for the integral parts of the equations. The equations are computerized and results are compared. Tables of values for resonance integrals, Dancoff correction values, and k_∞ are presented. (M.L.S.)

40543 (BNWL-SA-844) DEVELOPMENT OF MATHEMATICAL MODELS OF PRESSURE-TEMPERATURE TRANSIENTS IN REACTOR CONTAINMENT SYSTEMS DURING A LOSS-OF-COOLANT. Johnson, B. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 23, 1966. Contract AT(45-1)-1830. 19p. (CONF-661025-4; CONF-670201-3). Dep. CFSTI.

From Pacific Northwest Regional Meeting, American Institute of Chemical Engineers, Richland, Wash. and Symposium on the Impact of Low Cost Nuclear Power and Chemical Industry, Houston, Tex.

The development of mathematical models for predicting pressure and temperature transients that exist in the Containment System Experiment are outlined. The scope and purpose of the program, which investigates nuclear safety questions arising from potential reactor accidents, is first described. The models for transient conditions were developed with the aid of the Modified Integral Digital Analogue Simulation code (MIDAS) which provides a convenient method of solving sets of simultaneous differential equations. Examples of the results and the advantages and disadvantages of the use of the MIDAS code are discussed. (auth)

40544 (BNWL-SA-1360) ADMINISTRATIVE CONTROLS ON REACTOR EXPERIMENTS. Henry, H. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 20, 1967. Contract AT(45-1)-1830. 8p. (CONF-670713-5). Dep. CFSTI.

From 3rd Meeting of the Reactor Operations Division of the American Nuclear Society, Atlantic City, N. J.

A summary of the evolution of administrative controls for reactor experiments is given, starting with the Manhattan Project's CP-2. Reasoning behind administrative controls is presented. (M.L.S.)

40545 (CONF-660606-58) NUCLEAR HEATING CALCULATIONS IN A FAST-SPECTRUM, REFRACTORY-METAL REACTOR ASSEMBLY. Edwards, W. E.; MacDonald, J. E.; Robertson, C. S. Jr. (General Electric Co., Cincinnati, Ohio. Atomic Products Div.). June 20, 1966. 18p. (GE-TM-66-6-7). Dep. CFSTI.

From American Nuclear Society Meeting, Denver.

A detailed nuclear heating analysis was made of a fast-spectrum, refractory-metal reactor with a moderating reflector as part of the 710 Reactor Program. Two-dimensional S_N transport theory and Monte Carlo methods were used. An unusual feature of this analysis was the breaking of the γ source into four spatial zones and eleven energy groups. By computing the heating due to these sources separately and combining them at the end of the analysis sequence, it was possible to determine the origin of the nuclear heating in each component. The results clearly show the need for an accurate calculation of the neutron induced γ sources in extra-core structural materials. (auth)

40546 (CONF-661001-54) PIQUA NUCLEAR POWER FACILITY CORE UNLOADING AND INSPECTION. Seyfrit, K. V. (Piqua Nuclear Power Facility, Ohio); McEdwards, J. A. (Atomics International, Canoga Park, Calif.). [1966]. 30p. DTIE.

From 14th Conference on Remote Systems and Technology, Pittsburgh, Pa.

A description of PNPF is given. The operations history is outlined. The plan for visual inspection of the fuel elements is presented. The design of special handling tools for the fuel elements is discussed. Deformation of and external deposits on fuel elements due to the organic coolant are described. Sampling techniques for fuel element coke deposits are discussed. (M.L.S.)

40547 (CVNA-279) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC. RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report, October–December 1966. (Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Reactors Div.). Contract AT(30-1)-2289. 75p. Dep. CFSTI.

An operations history of the CVTR is given. Data from primary system pressure drops are tabulated. Detection of higher-than-normal radioactivity levels in the primary coolant is outlined. Differential moderator worth measurements are discussed; results are presented. Integral control-rod worth measurements and moderator temperature coefficient measurements are outlined. Results from flux wire irradiations are tabulated. A history of fuel leaks at power operation is presented. Results of burnup measurements are presented graphically. On-site gamma scans of two defective high-power-density test assemblies are discussed; data are shown as a function of distance above bottom of fuel. Power distribution measurements are given. A safety analysis report is presented. (M.L.S.)

40548 (CVNA-284) CVTR POST-CONSTRUCTION R AND D PROGRAM. CVPC-24 RADIATION ANALYSIS. Snyder, W. R. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). July 1967. Contract AT(30-1)-2289. 145p. Dep. CFSTI.

Radiation analysis for the CVPC-2A is described. The analysis includes: reactor coolant fission and corrosion product activity; moderator system corrosion product activity; component cooling water corrosion product activity; corrosion product deposited activity; neutron detector measurements; and vapor container atmosphere. The radiation survey analysis completed includes data for: radiation levels during full power operation which consists of radiation in reactor coolant and moderator system, radiation levels inside primary concrete, radiation of outside vapor container, and shield temperature; radiation levels during cold shutdown which consists of survey inside the vapor container, header cavity, and streaming survey; and radiation levels during refueling. (D.C.C.)

40549 (DOCKET-50-29(Amend.52)) AMENDMENT NO. 52 TO LICENSE APPLICATION DATED JUNE 29, 1956 (DOCKET NO. 50-29). (Yankee Atomic Electric Co., Boston, Mass.). Aug. 2, 1967. 24p. Dep. CFSTI. AECW.

Contents of proposed Amendment No. 52 to Yankee Atomic Electric Company license application dated June 29, 1956 (Docket No. 50-29) are presented. Proposed changes involve: capillary vent system, control rod assemblies, core loading configuration for Core VI, Zircaloy core test assemblies, and core thermocouples. (D.C.C.)

40550 (DUN-SA-35) SPACE-TIME PROBLEMS IN LARGE REACTORS. Bailey, G. F. (Douglas United Nuclear, Inc., Richland, Wash.). Apr. 21, 1967. Contract AT(45-1)-1857. 27p. Dep. CFSTI.

Control of a large, loosely-coupled reactor is discussed. The space-time effects on reactor control are considered in detail. Flux profiles during an excursion in a large, one-dimensional core are presented. Various characteristics of a safety control system are related to overall reactor control. (M.L.S.)

40551 (EURFNR-284) REMARKS ON SERIOUS ACCIDENTS (BASIS OF A NEW QUANTITATIVE ACCIDENT PHILOSOPHY). Schikarski, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Translation of report KFK-530. 15p. Dep.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

The MCA concept, which was imported into Germany along with the construction of American reactors under license, was a useful safety term as long as the reactors under discussion were of low or medium power. At the phase now commencing, in which large units are to be built closer to centers of population, two primary difficulties of the MCA concept emerge, namely: the need to make the site of the large nuclear power plants now to be built as independent as possible by using special engineered safeguards, of which only inadequate account is taken with the MCA concept; probabilities must be assigned both to individual accidents making up the accident and to the operation or failure of safety devices. This is not covered in the MCA concept. With the basic accident concept, a conservative basic accident and the danger potential are first determined. By assigning probabilities to individual occurrences making up accidents and to engineered safeguards, quantitative information can be obtained on the safety of a reactor and hence the safety of different reactors compared. By means of quantitative data on probabilities the vague MCA value can be replaced by the "safety hazard" idea, which is obtained from the product of the danger potential and the corresponding probabilities. Furthermore, the safety assessment of engineered safeguards is placed on a quantitative basis. (auth)

40552 (EURFNR-320) EXPERIENCE WITH NETWORK ANALYSIS AND ITS FURTHER DEVELOPMENT FOR THE PURPOSE OF PLANNING OBJECTIVES AND TIME SCHEDULING WITHIN THE FRAMEWORK OF THE KARLSRUHE FAST BREEDER PROJECT. Gmelin, W.; Seetzen, J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). May 1967. 9p. (KFK-593; CONF-670540-1). Dep.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

From Symposium on International Congress for Project Planning, Vienna, Austria.

The computer program analysis of project organization and operation to build large competitive fast breeder power stations

of about 1000 MW(e) before 1980 is presented. The program described is the TERM-1 for the IBM-7074. (D.C.C.)

40553 (GA-6881) MULTIMILLION KILOWATT HTGR: A DESALINATION REACTOR SCALEUP STUDY. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). May 19, 1967. Contract W-7405-eng-26; Subcontract No. 2543. 174p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

REACTORS, GAS-COOLED—design parameters for high-temperature; xenon instabilities in large high-temperature, effects of size on; coolant flow analysis for; neutron effects on graphite core and moderator for high-temperature, fast; pressure vessels for high-temperature, development of prestressed concrete; fuel cycle economics for large high-temperature; economics of high-temperature; use for desalination of high-temperature

XENON—oscillation effects on control of large reactors; oscillations in large high-temperature gas-cooled reactors, monitoring and control of

NEUTRONS—leakage rates in high-temperature, gas-cooled reactor, effects of size on

BOILERS—design parameters for 10,000 MW plant

HELIUM—flow analysis in high-temperature gas-cooled reactors

GRAPHITE—neutron irradiation in high-temperature gas-cooled reactors on, effects of fast

DESALTING—use of high-temperature gas-cooled reactor for feasibility study on (M.L.S.)

40554 (GEAP-5507) HIGH POWER DENSITY DEVELOPMENT PROJECT TWENTY-SEVENTH AND TWENTY-EIGHTH QUARTERLY PROGRESS REPORTS, DECEMBER 1966-MAY 1967. Worthington, J. T.; Hazel, V. E. (comps.) (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). June 1967. Contract AT(04-3)-361. 17p. Dep. CFSTI.

Thirteen developmental fuel assemblies accumulated exposure as part of an 84-bundle core in the Consumers Big Rock Point reactor until a scheduled shutdown on May 19, 1967. During the May, June 1967 reactor shutdown, several of the developmental assemblies were visually inspected. Dimensional profiles were obtained on selected fuel rods. Fission-product activity release measurements on developmental assembly D-4 indicated that it contained leaking fuel rods; however, examination of this assembly revealed no visible fuel rod failures. This assembly contains Incoloy-800-clad, sintered pellet UO_2 fuel rods at an average exposure of 9910 MWd/TU. It is not planned to continue irradiation of this assembly. Visual inspection of other developmental assemblies (PO-3, D-2, D-8, and D-17) containing fuel rods clad with Type-304 stainless steel Zircaloy-2 and Incoloy-800, and fabricated by various processes, revealed no failed fuel rods. Nonuniform deposition was observed on all peripheral fuel rods. Variations in the appearance of the deposits were observed both along the length of the fuel rods and around the circumference. Approximately 280 fuel rods have been removed and reinserted in the various developmental fuel assemblies, verifying the feasibility of the removable fuel rod assembly design. The core loading for the next reactor operating period which is scheduled to start June 1967, includes a total of 11 developmental assemblies: one Group I assembly, PO-4; eight Group II assemblies, D-1 through D-3 and D-5 through D-9; and two Group III assemblies, D-16 and D17. Post-irradiation examination of selected developmental fuel rods has begun. Visual examination, gamma scanning, and profilometry of the fuel rod segments are complete. The most significant observation was a missing fuel rod bottom end plug from assembly D-19. (auth)

40555 (GECR-5155) FEASIBILITY STUDY OF BOILING WATER REACTOR NUCLEAR STEAM SUPPLY SYSTEMS WITH CAPACITIES UP TO 10,000 MWt. Final Report. Lockhart, R. W. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Feb. 1967. Contract W-7405-eng-26; Subcontract 2606. 127p. Dep. CFSTI.

For Union Carbide Corp., [Y-12 Plant], Oak Ridge, Tenn.

The feasibility of using large boiling water reactors as power plants is examined. A design is given for a 10,000 MW system and is discussed. Systems investigated include: reactor vessel, core size, core integral equipment, and coolant recirculation pumps. Reactor optimization is detailed; on-line refueling is discussed. (M.L.S.)

40556 (IDO-17220) CONTEMPT: A COMPUTER PROGRAM FOR PREDICTING THE CONTAINMENT PRESSURE-TEMPERATURE RESPONSE TO A LOSS-OF-COOLANT ACCIDENT. Richardson, L. C.; Finnegan, L. J.; Wagner, R. J.; Waage, J. M. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). June 1967. Contract AT(10-1)-205. 81p. Dep. CFSTI.

The CONTEMPT computer program predicts the pressure-temperature response of a dry well containment building to a loss-of-coolant accident. This report describes the analytical model developed for the containment response and also serves as the user's guide for the computer program. The model assumes that the loss-of-coolant accident can be separated into phases, such that the results of the analysis of one phase serves as the initial conditions or the time-dependent input to the next phase. Thus, the containment model is only concerned with the pressure and temperatures in the containment volume and the temperatures through the containment structure. The computer program input provides for the description of the discharge of coolant, the boiling of residual water by reactor decay heat, the superheating of steam passing through the core, and metal-water reactions. The containment volume is separated into a liquid region and vapor region. Each region is assumed to have a uniform temperature, but the temperatures of the two regions may be different. The containment building is represented as consisting of several heat-conducting structures whose thermal behavior can be described by the one-dimensional multi-region heat-conduction equation. The program also calculates building leakage and the effects of engineered safeguard devices. (auth)

40557 (IITRI-578P21-29) STUDIES OF REACTOR CONTAINMENT. Progress Report for April-May 1967. Gallagher, E. V. (IIT Research Inst., Chicago, Ill.). Contract AT(11-1)-578. 50p. (IITRI-T6042-29). Dep. CFSTI.

Analysis of data obtained from experiments in a water shock tube, using a 6 foot driver section, is presented. Data were obtained on the following: effects of initial temperature differences of the driver fluid, comparison of experimental data with simple quasi-steady calculations, effects of initial vapor regions in the driver, comparison of flow-obstruction models with and without rods present, and speed of the initial decompression wave. Modification of the driver section to a 12 foot length is outlined. Results of analytical calculations of blowdown of compressed liquid water are discussed. A description of the data processing system is given. (M.L.S.)

40558 (JAERI-1136) JPDR THERMAL AND HYDRAULIC CHARACTERISTICS MEASURED BY AN INSTRUMENTED FUEL ASSEMBLY (IFA) AND THEIR ANALYSES BY A COMPUTER CODE "JP-HYDRO". Uga, Takeo (Japan Atomic Energy Research Inst., Tokyo). May 1967. 17p. Dep.

The incore thermal and hydraulic characteristics of JPDR were measured, using the instrumented fuel assembly IFA with two flowmeters and six thermocouples for measuring the channel coolant flow rate, exit steam quality, and subcooling as a function of the reactor power. In addition, the method for calculating the core average exit steam quality and total circulation flow rate was developed by combining one-point measured values in the X-Y plane and the JP-Hydro code used for the natural or forced circulation boiling loop for a multi-channel and multi-riser. The hydraulic model for the IFA channel was prepared by modification of that of the standard fuel channel. The hydraulic characteristics of a fuel channel are influenced by the existence of the instruments attached to the fuel. Especially, the pressure drop due to turbine type flowmeters is considerably large. The overall thermal and hydraulic characteristics of JPDR can be estimated by the IFA channel flow iteration method in the computer code "JP-Hydro". Total circulation flow rate at the full power is about 1,625 t/hr. Estimated carryunder steam quality is proportional to reactor power, and its ratio to the exit steam quality is approximately 0.2. (auth)

40559 (KAPL-3359) ASYMPTOTIC FORMULAS FOR INITIAL-VALUE PROBLEMS OF NON-LINEAR DIFFERENTIAL EQUATIONS WITH A SMALL PARAMETER MULTIPLYING THE DERIVATIVE. MacMillan, Donald B. (Knolls Atomic Power Lab., Schenectady, N. Y.). June 30, 1967. Contract W-31-109-eng-52. 55p. Dep. CFSTI.

Asymptotic methods for the approximate solution of systems of ordinary differential equations in which some of the variables have very short response times on the time scale of the interesting behavior of the system are given. Systems of this kind arise in various application areas. In particular, the reactor kinetics equations are such a system. The approximating differential equations described may be solved numerically at reasonable time steps in terms of the interesting behavior of the system. (18 references). (auth)

40560 (KAPL-M-6711) MULTICHANNEL VARIATIONAL SPACE-TIME SYNTHESIS WITH DISCONTINUOUS EXPANSION FUNCTIONS. Stacey, Weston M. Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). June 27, 1967. Contract W-31-109-eng-52. 25p. Dep. CFSTI.

Multichannel space-time synthesis equations have been derived

from a variational principle for the time-integrated P_1 equations. Discontinuous expansion functions are admitted in the formalism. (auth)

40561 (KAPL-M-6713(Rev.A)) TER4: REACTOR TRANSIENT ANALYSIS PROGRAM. Fruhauf, C. L. (Knolls Atomic Power Lab., Schenectady, N. Y.). May 1967. Contract W-31-109-eng-52. 61p. (KAPL-M-SR-2(Rev.A)). Dep. CFSTI.

TER4 (FORTRAN IV, CDC 6600) is an open loop reactor transient program which determines reactor power and temperature transients resulting from the insertion or removal of reactivity. By open loop is meant that feedback from the secondary system is neglected. Reactivity may be inserted or removed by control rod motion and/or changes in reactor coolant temperature combined with the temperature coefficient effect. The space independent, one energy group, reactor kinetics equations with six delayed neutron groups are solved using Euler's method. For the thermal calculations, a one dimensional heat transfer model of a one pass reactor is employed. The number of nodes in both the axial and radial directions is variable. Only the nominal channel is considered. Program output includes reactor power level, total reactivity, reactor period, reactor rate, nominal channel temperatures (coolant, clad, and fuel), and integrated reactor power. Reactor rate is inverse of reactor period. (auth)

40562 (KFK-545) DIE ENTWICKLUNG VON DAMPFGEBLAESEN FUER DAMPFGEKUEHLTE REAKTOREN. (The Development of Steam Blowers for Steam-Cooled Reactors). Erbacher, F.; Radtke, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Feb. 1967. 76p. (In German). Dep.

The Institute for Reactor Development has been working on the development of steam-cooled reactors since 1961. The characteristics of the steam circuit for such a reactor and the factors governing the selection of the steam state are outlined. The components of the coolant circuit are given and special design considerations for the development of steam blowers are discussed. The operational behavior of the prototype steam blower developed is reported. Design points for the further development are considered. The blower characteristics necessary for high reactor power are given. (J.S.R.)

40563 (LA-3760) ADVANCED REACTOR TECHNOLOGY (ART). PART I. Quarterly Status Report for Period Ending July 31, 1967. (Los Alamos Scientific Lab., N. Mex.). Aug. 1967. Contract W-7405-eng-36. 15p. Dep. CFSTI.

Cold critical experiments on UHTREX are discussed. Reactivity calibration of control rods and fuel elements are presented. Results of particle self-shielding calculations are evaluated. Stability and feed back calculations are discussed; results are tabulated. Heat pipe testing and evaluation are presented. (M.L.S.)

40564 (NAA-SR-12395) AEC UNCLASSIFIED PROGRAMS QUARTERLY TECHNICAL PROGRESS REPORT, JANUARY-MARCH 1967. (Atomics International, Canoga Park, Calif.). May 31, 1967. Contract AT(04-3)-701. 184p. Dep. CFSTI.

Developments are reported for studies on: cross section analysis; integral reactor-physics experiments; basic-theory improvement; fast spectrum Doppler measurements; boiling studies for sodium reactor safety; measurement of Doppler coefficients; reactor dynamics simulator development; fission product contamination control; characterization of Na fires and fission product release; fission effects in metal fuels; Sodium Reactor Experiment operation; refractory moderator materials; FBR fuel development, fuel cladding, and structural materials; coolant chemistry; materials management; mechanical properties; dynamic loop testing; modes of failure and He degradation; basic properties of UC type fuels; Na chemistry; HNPF retirement; PNPF fuel elements; high temperature chemistry; radiation chemistry; electronic structure of metals and alloys; radiation damage in crystalline solids; and radiation chemistry of chromosomes. (P.C.H.)

40565 (NP-16898) ANALYSIS OF THE NUCLEAR FUEL CYCLE MARKET STRUCTURE. Monks, Joseph Gerard (Washington Univ., Seattle). 1967. 339p.

Thesis.

An analysis of the emerging market structure in the nuclear fuel cycle industry is presented. A model for economizing our nuclear resource is first developed. It accommodates demands arising from democratic, bureaucratic, and bargaining techniques, as well as the traditionally emphasized pricing mechanism. Supply comes from fuel cycle firms who stress various aspects of their marketing mix, which is composed of product, distribution, promotion, and price variables. Data from firms in all phases of the fuel cycle are presented to identify the market structure as it exists now and anticipate changes in the future. Buyers, sellers, resources, barriers to entry, etc., are discussed for each phase. Some techniques are presented for handling uncertainties with respect to phase capacity and U_3O_8 prices. Investment, cost, and profit data are also presented. Competition in fuel cycle activities is technological in nature. Large firms with strong financial resources and innovation capabilities are destined to dominate all phases of the cycle as they capitalize upon monopolistic advantages peculiar to their own mix of abilities. Continued vertical integration by large firms into several phases of the cycle seems likely. Prices for most fuel cycle services are expected to decline, some rather sharply. The prices of U_3O_8 may fluctuate, but this analysis concludes they will not rise substantially, as most mining and milling firms expect. Sales of all fuel cycle services should rise from less than half a billion dollars annually now to about $2 billion by 1980. The market value of capital investment in most phases will more than double by 1975. Profits will be supported by technological improvements, but this will be offset by continued overcapacity as firms discount anticipated profits in their battle for lucrative future market positions. (auth)

40566 (NYO-3622-10) APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS. Bimonthly Progress Report No. 35, June 1, 1967-July 31, 1967. (Aeroprojects, Inc., West Chester, Pa.). Aug. 1967. Contract AT(30-1)-3622. 11p. Dep. CFSTI.

Development of ultrasonic instrumentation for incipient boiling detection in liquid metals or fused salts is outlined. Flow rate experiments using an ultrasonic flowmeter are presented. (M.L.S.)

40567 (ORNL-4148) GAS TRANSPORT IN MSRE MODERATOR GRAPHITE. I. REVIEW OF THEORY AND COUNTER-DIFFUSION EXPERIMENTS. Malinauskas, A. P.; Rutherford, J. L.; Evans III, R. B. (Oak Ridge National Lab., Tenn.). Sept. 1967. Contract W-7405-eng-26. 39p. Dep. CFSTI.

Equations describing gas transport in porous media are derived. Many simplifying assumptions are made in deriving the formulas. Development of the theory proceeds logically from gas transport of a pure gas in a single capillary, to transport of a binary gas mixture in a single capillary, to gas flow through a bundle of capillaries, and, finally, to gas flow through a porous medium. Equations are given for each type of transport. Practical applications of the theoretical concepts are also shown for a moderator graphite of the type used in the Molten-Salt Reactor Experiment (MSRE). The experimental findings are limited but significant. Under MSRE conditions it appears quite justifiable to ignore normal diffusion effects in gas transport computations. This means that all the gaseous diffusion information necessary to correlate fission product migration data may be gained through simple permeability measurements; the more complex interdiffusion experiments are not required. Thus a complete flow-property survey of all MSRE moderator materials can be performed with a minimum expenditure of time and effort. (auth)

40568 (ORNL-NSIC-36) INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE-10. (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 373p. Dep. CFSTI.

A bibliography of nuclear safety information is presented. Topics covered include: general safety criteria; siting of nuclear facilities; transportation and handling of radioactive materials; aerospace safety; accident analysis; reactor transients, kinetics, and stability; fission product release, transport, and removal; sources of energy release under accident conditions; nuclear instrumentation, control, and safety systems; electrical power systems; containment of nuclear facilities; plant safety features; radiochemical plant safety; radionuclide release and movement in the environment; environmental surveys, monitoring and radiation exposure of man; meteorological considerations; operational safety and experience; safety analysis and design reports; bibliographies. A selector index and author index is provided. Availability for all items is listed. (M.L.S.)

40569 (ORNL-P-3249) OPERATING EXPERIENCE WITH THE HFIR PROTECTION SYSTEM. Bates, A. E. G.; Epler, E. P.; Oakes, L. C. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 15p. (CONF-670713-4). Dep. CFSTI.

From 3rd Meeting of the Reactor Operations Division of the American Nuclear Society, Atlantic City, N. J.

The ORNL second generation of reactor protection systems has been applied successfully to the HFIR. Testing for unsafe component failures, routine maintenance and most repair work to the system are all done routinely while the reactor is at power. On-line maintenance has advantages over off-line maintenance in addition to conservation of down-time, and tends to enhance safety. Well designed systems employing general coincidence logic and having at least as many as seven inputs, probably will contribute less than one spurious scram per year. The HFIR is a production reactor and the techniques and hardware arrange-

ments employed in the design of its protection system have resulted in high system reliability. (auth)

40570 (ORNL-TM-1545) DESIGN STUDY OF A HEAT-EXCHANGE SYSTEM FOR ONE MSBR CONCEPT. (Oak Ridge National Lab., Tenn.). Sept. 1967. Contract W-7405-eng-26. 203p. Dep. CFSTI.

The heat-exchange system for one concept of a 1000-MW(e) nuclear power plant using a molten-salt breeder reactor has been studied. The system has five types of heat exchangers to transfer the heat generated in the reactor core to the supercritical steam energy required to drive the turbine for the generation of electrical power. The two major design approaches are for flow circuits in which heat is transferred from the molten core fuel and fertile blanket salts to the molten coolant salt and then to the supercritical fluid. The Case-A system involves relatively high fuel- and blanket-salt pressures in the reactor core. These pressures are reduced in the Case-B system by reversal of the flows of the fuel and blanket salts through the reactor core and the respective pumps and exchangers, while the operating pressures of the coolant-salt system are raised above those in the Case-A system. The criteria used, assumptions made, relationships employed, and the results obtained in the design for each of the five types of exchangers used in these cases are reported. Although the resulting design for the Case-B heat-exchange system and the exchangers appears to be the most workable one, further experimental and analytical investigations are needed before the designs for these exchangers can be finalized. (auth)

40571 (ORNL-TM-1913) ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM. Bimonthly Report, May–June 1967. Cottrell, Wm. B. (Oak Ridge National Lab., Tenn.). July 10, 1967. Contract W-7405-eng-26. 79p. Dep. CFSTI.

Work on various chemical reactions, as well as the release, characterization, and transport of fission products in containment systems under various accident conditions and on problems associated with the removal of these fission products from gas streams is presented. Although most of the work has been in the past, and continues to be, in general support of water power reactor technology including some in direct support of the LOFT and CSE programs, several projects are conducted in support of the High-Temperature Gas-Cooled Reactor (HTGR) Program, including both in-pile and out-pile studies of the reaction rates and fission product release and transport phenomena. Other major projects include fuel transport safety investigations, a series of discussion papers on various aspects of water reactor technology, anti-seismic design of nuclear facilities, and the studies of pressure vessel technology. Experimental work relative to pressure vessel technology includes investigations of the attachment of nozzles to shells and the implementation of this joint AEC-PURC programs on Heavy Section Steel Technology and Nuclear Piping Pumps and Valves. Several of the projects are concerned with the development of engineering safeguards and the establishment of codes and standards for these safeguards while another task (CHORDS) is concerned with the establishment of computer programs for the evaluation of reactor design data. The recent activities of the NSIC and the Nuclear Safety journal in behalf of the nuclear community are also discussed. (auth)

40572 (ORNL-TM-1946) REVIEW OF MOLTEN SALT REACTOR PHYSICS CALCULATIONS. Carlsmith, R. S.; Bennett, L. L.; Edison, G. E.; Gift, E. H.; Thomas, W. E.; Welfare, F. G. (Oak Ridge National Lab., Tenn.). Aug. 16, 1967. Contract W-7405-eng-26. 58p. Dep. CFSTI.

A set of calculations was made to check the reactivity and breeding ratio of the reference design of the MSBR. Insofar as possible, the cross sections and calculational methods were made independent of those used previously. The reference composition gave a k_{eff} of 0.95. When the reactor was made critical by the addition of 14% more ^{233}U, the breeding ratio was 1.062 compared with 1.054 in the previous calculations. Reoptimization of the composition would probably decrease this difference in breeding ratio. (auth)

40573 (PRWRA-113) BONUS NUCLEAR POWER STATION, RINCON, PUERTO RICO EMERGENCY PLAN, REVISION NO. 3. Bonnet, Juan A. Jr.; Bayron, Luis A. Martinez (Puerto Rico Water Resources Authority, San Juan). May 1967. 51p. (WRA-B-67-14). Dep. CFSTI.

Detailed emergency procedures for BONUS are given. Alarm signals and emergency actions are detailed. Evacuation and damage control are discussed. Emergency personnel organization is given. (M.L.S.)

40574 (RM-5148-PR) FAST BREEDER REACTORS AND THE SPREAD OF PLUTONIUM. Gilinsky, V. (RAND Corp., Santa Monica, Calif.). Mar. 1967. 52p. CFSTI.

Present efforts to provide safeguards against the possible future spread of nuclear weapons must recognize that the production of nuclear power can no longer be considered an economically marginal activity. Furthermore, Pu is expected to become a major fuel for the generation of electrical power in industrial countries in about twenty years. The present transition from coal and oil burning power plants to U burning nuclear power reactors will be followed after some years by an equally significant transition to Pu burning fast breeder reactors. This last change will eventually lead to the presence of large rapidly multiplying stocks of Pu in industrial countries. Furthermore, the expectation of the coming importance of Pu may now make advanced countries reluctant to agree to any international control of fissionable material that interferes with its industrial use. (auth)

40575 (STL-372-50) KINETIC STUDIES OF HETEROGENEOUS WATER REACTIONS. Annual Summary Report, 1966. Firstenberg, A. F.; Humberstone, G. H.; Neal, L. G.; Wentz, L. B.; Zivi, S. M. (TRW Systems, Redondo Beach, Calif. Physical Electronics Lab.). Dec. 1966. Contract AT(04-3)-372. 129p. Dep. CFSTI.

REACTORS, WATER-COOLED — accident conditions in, pressure generation in; fuel elements for, effects of melting of; fuel elements for, in-core pressures from meltdown of; steam–void formation in, in-core capsule measurements of; transfer function measurements during subcooled boiling in, power-void
REACTOR SAFETY — accident conditions in water-cooled reactors, pressure generations in; meltdown accidents in power reactors, in-core pressures from
REACTOR SAFETY EXPERIMENTS — pressure and temperature effects in KEWB, measurement of
REACTOR FUEL ELEMENTS — melting of water-cooled, effects of; meltdown of water-cooled, in-core pressures from
METALS — water reactions with molten, effects on water-moderated reactors of
PRESSURE — generation of transient, evaluation of reactor accidents involving; generation using shock-tubes; generation of, effects of chemical energy release on
REACTOR FUELS — effects on pressure generation of low-conductivity oxide
HEAT TRANSFER — calculations for urania fuels in water-moderated reactors, time-dependent
URANIUM OXIDES UO_2 — pressure generation from water impact with hot powdered
REACTORS, POWER — stability of, two-phase flow effects on
EXPERIMENTAL BOILING WATER REACTOR — stability of, hydrodynamic analysis of
REACTIVITY — feedback effects on reactor stability
BOILING — transfer function measurements in subcooled, power-void
FLUID FLOW — distributional effects in two-phase, analysis of
(M.L.S.)

40576 (SV-58/67) AGESTA KRAFTVAERERMEVERK-ARSRAPPORT OCH ERFARENHETER FRAN DRIFTEN UNDER TIDEN 1 JAN. 1966–31 DEC. 1966. (Operation of the Agesta Nuclear Heat and Power Reactor. Annual Report Covering January–December 1966). Rylander, H. (Swedish State Power Board, Stockholm). Mar. 8, 1967. 50p. (In Swedish). Dep.

For maximum burnup the reactor is generally operated at 65 MW. The burnup for the reported period is 347,000 MWh. The total burnup from the initial startup is 642,000 MWh equivalent of 1620 MWd/ton U. The in-pile irradiation of the fuel elements I and II for the Marcviken Power Reactor is finished, and the in-pile irradiation of four Pu-enriched fuel test elements and one U-235 enriched boiling fuel element for the Oskarshamn Reactor has started. A small leak in the primary system is detected and repaired. During the reported period there has been 10 heat supply interruptions. Three of them were planned and seven were random. Two of them were of long time and five of short time duration. (auth)

40577 (TID-23946) EXPERIMENTAL INVESTIGATION OF SPATIAL EFFECTS ON THE NEUTRON FLUCTUATION SPECTRA OF A LARGE NUCLEAR REACTOR. Buhl, Anthony Ray (Tennessee Univ., Knoxville). Dec. 1967. 141p. Dep. CFSTI.

Thesis.

The experimental techniques used to determine the spatial dependence of neutron fluctuation spectra in large reactors is detailed. Cross-power spectral densities are measured by the use of a two-detector system. Instrumentation utilized is described in detail. The experiment configuration at the 305 Test Pile at Savannah River is described; experiment conditions are detailed. A tabular summary of data is presented. Data reduction is explained. Analysis of data recorded from each detector is presented graphically. Data are compared with theoretical predic-

tions. Instrument details are presented; a computer printout of the program SEN (spatial effects on noise) is listed. 31 references. (M.L.S.)

40578 (TRG-REPORT-1494) METHODS IN USE AT D.E.R.E. FOR THE MEASUREMENT OF BURN-UP OF NUCLEAR FUELS AND NEUTRON DOSE. Diggle, W. R.; Gaunt, A. J.; Melhuish, K. R.; Newman, E. E. (United Kingdom Atomic Energy Authority, Dounreay (Scotland). Reactor Group). Apr. 17, 1967. 35p. Dep. CFSTI. UK 5s.

The methods for burnup and neutron dose measurements are described and the relevant calculations and nuclear data used are given. Methods include: measurement of changes in isotopic composition of fuel, measurement of radioactive and stable fission products, and the use of flux monitors. The limitation and accuracy of each method is discussed. (auth)

40579 (UCID-15192) LIQUID METAL REACTORS. Brown, Norman (California Univ., Livermore. Lawrence Radiation Lab.). Oct. 21, 1966. Contract W-7405-eng-48. 24p. Dep. CFSTI.

The engineering design of a multi-megawatt liquid metal cooled reactor is presented. Derivation of the approximate sizes, conditions, etc., for two fuel element configurations is discussed. (auth)

40580 (WAPD-MRP-121) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, April 21, 1967-July 21, 1967. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Contract AT-11-1-GEN-14. 96p. Dep. CFSTI.

Leak testing of generators for Shippingport is discussed. End-of-life tests in Seed 1 are outlined. Coolant pH effects on core pressure drop are discussed. Results of multiport valve testing are discussed. The procedures for replacing Seed 1 with Seed 2 are outlined. Spent fuel examination is presented. A reactor kinetics evaluation of Seed 2 is given. Seed 1 reactivity and flux measurements are compared with calculated values. Depletion predictions for Seed 2 are presented. Fuel element development is discussed. Radiation effects on fuel plates are tabulated. Results of corrosion tests on fuel materials are given. (M.L.S.)

40581 (WAPD-TM-666) FLASH-2: A FORTRAN IV PROGRAM FOR THE DIGITAL SIMULATION OF A MULTINODE REACTOR PLANT DURING LOSS OF COOLANT. Redfield, J. A.; Murphy, J. H.; Davis, V. C. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Apr. 1967. Contract AT(11-1)-Gen-14. 90p. Dep. CFSTI.

The FLASH-2 digital computer program calculates coolant flows, coolant inventories, pressures, and temperatures in both coolant and fuel in a water reactor system during a loss-of-coolant accident. Thus the program provides a basis for predicting the consequences of such an accident, or the effectiveness of safety systems to mitigate these consequences. FLASH-2 is a major revision of the original FLASH program which includes model improvement, geometric flexibility and improved computational efficiency. (auth)

40582 (WAPD-TM-675) A SIMPLE METHOD TO INCORPORATE HETEROGENEOUS AND DOPPLER BROADENING EFFECTS IN THE MUFT-5 RESONANCE TREATMENT. LWB-LSBR Development Program. Steen, N. M.; Hanson, J. N. (Bettis Atomic Power Lab., Pittsburgh, Pa.). July 1967. Contract AT(11-1)-Gen-14. 39p. Dep. CFSTI.

A method has been developed to permit the current MUFT-5 program to consider directly the resonance absorption in heterogeneous systems in the presence of Doppler broadening at a prescribed temperature. This method does not require any program changes and is simple to use. An approximate technique is included to account for resonance overlap, which is important in fissile nuclides. One of the characteristics of this method is that the resonances integral for a nuclide is precisely determined for certain systems of primary interest. (auth)

40583 (WCAP-3680-4) CONTROL OF XENON INSTABILITIES IN LARGE PWR'S. Quarterly Progress Report for the Period Ending June 30, 1967. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). July 1967. Contract AT(30-1)-3680. 72p. (EURAEC-1880). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

A simple correlation was developed to correct xenon-oscillation results for the errors caused by using finite steps in diffusion theory calculations. The use of a finite time-step introduces errors because the flux is assumed constant during the time-step. The calculations performed verify that for unstable cores a non-zero time-step will result in calculated oscillations which are relatively more stable than in the limit of a zero time-step. A useful index of the influence of various core parameters on Xe-induced spatial instabilities was developed within the linearized modal-expansion theory. Results from the one-dimensional diffusion theory calculation for an unstable core show that small perturbations can excite diverging oscillations. Xe-induced oscillations in the x-y plane were studied in the 11-ft core with fuel temperature feedback for a dished, steady-state power distribution. (D.C.C.)

40584 (WCAP-3696-4) PRESSURIZED WATER REACTOR pH-REACTIVITY EFFECT. Quarterly Progress Report for the Period Ending June 30, 1967. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). July 1967. Contract AT(30-1)-3696. 51p. (EURAEC-1878). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Four instrumented rods are being constructed for the Saxton Reactor 3 × 3 fuel subassembly to study the effect of corrosion product deposits and coolant chemistry (pH) on heated surfaces with respect to heat transfer, pressure drops, fluid friction, steam void formation, deposition rate, adherence to surfaces, and transport in general. Both cermet and UO_2 pellet type rods will be used with each one containing an imbedded thermocouple. The fabrication procedures of the enriched UO_2–stainless steel core fuel tubes are presented. The fabrication procedures for the enriched UO_2–cermet rods are also presented. A preliminary design for the out-of-pile loop test section is established. The results of the previous Selni pH test are discussed, and analyses of the primary coolant samples are presented. Scram tests performed at the Saxton Reactor indicate that the pH reactivity effect cannot be accounted for by fuel temperature changes alone. In-pile tests of the temperature distribution in a large oscillator showed that the maximum Ag–In–Cd absorber temperature would be 1350°F when the reactor was operating at 35 MW(t). (D.C.C.)

40585 (AEC-tr-6894) HETEROGENEOUS NUCLEAR REACTOR. Translated from German Patent 1,830,495. 10p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

The design of a heterogeneous reactor with an irregular arrangement of the fuel and a geometrical arrangement of the moderator in lattice form is given. (J.C.W.)

40586 (AEC-tr-6895) HETEROGENEOUS NUCLEAR REACTOR. Translated from German Patent 1,905,603. 8p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

A design of a heterogeneous reactor with a lattice arrangement of channels within the fuel for a coolant simultaneously acting as a moderator is given. (J.C.W.)

40587 (JPRS-42067) CERTAIN PROBLEMS IN THE MATHEMATICAL THEORY OF THE CRITICAL STATE OF REACTORS. Shikhov, S. B. Translated from Zh. Vychisl. Mat. i Mat. Fiz., 7: 113-27(1967). 18p. (TT-67-32697). CFSTI.

The basic reactor kinetics equations are solved in probabilistic notation. Neutron thermalization is expressed in terms of the differential scattering cross section. The properties of the operators L and K are developed; conjugate operators are defined. A theorem on existence and uniqueness of the critical equation is proven. A solution to the dynamics equations for reactors is presented. 9 references. (M.L.S.)

40588 A SIMPLIFIED DIRECT REACTIVITY METER FOR D_2O-MODERATED SYSTEMS. Dierckx, R.; Marchal, A.; van Wauwe, A. (EURATOM, Ispra, Italy). Nucl. Appl., 3: 532-9 (Sept, 1967).

The use of a direct reactivity meter for control-rod calibration was studied. The reactor model was simplified by reducing the number of delayed-neutron and photoneutron groups from 15 to 6, and by putting dn/dt equal to zero, without greatly affecting the accuracy of the reactivity measurements. The influence of errors in the knowledge of the parameters of the remaining six delayed-neutron groups was studied. Measurements were made on two reactors: ECO, a cold reactor; and ISPRA-I, a reactor with a strong long-lived photoneutron source. The measurements performed with the direct reactivity meter were compared to normal rod-drop measurement techniques and period measurement techniques, and were found to agree in general to ±2%. The long-lived source term, which depends on the reactor operation history, was found to a precision of better than ±1%. (auth)

40589 FUEL PROPERTIES AND NUCLEAR PERFORMANCE OF FAST REACTORS FUELED WITH MOLTEN CHLORIDES. Nelson, P. A.; Butler, D. K.; Chasanov, M. G.; Meneghetti, D. (Argonne National Lab., Ill.). Nucl. Appl., 3: 540-7(Sept, 1967).

The characteristics of fast reactors having molten fuels consisting of UCl_3 and $PuCl_3$ dissolved in alkali chlorides and alkaline-earth chlorides were studied. The study included considerations of the physical and chemical properties of the fuel, the heat-removal problems, and neutronic characteristics for three types of chloride reactors: a homogeneous reactor and two internally cooled reactors. Optimization of the core size for 1000-MW(e)

reactors resulted in a core volume of 10,000 liters for each type. These reactors have the favorable characteristics (even for natural Cl_2) of high breeding ratio, large negative temperature coefficients of reactivity, and low fuel-cycle costs. However, the unattractive characteristics of large Pu inventory, large volume, complex design, and container material problems indicate that a sizeable program to develop chloride-fueled reactors would be required. 36 references. (auth)

40590 OPTIMIZATION OF REACTOR SHUTDOWN MARGIN MEASUREMENTS IN HIGH GAMMA FLUXES. Roux, D. P. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 3: 575-80(Sept. 1967). (ORNL-P-3015).

Since the quality of subcriticality measurements using neutron noise analysis in power reactors is degraded by high gamma-ray intensities produced by residual fission products, a study was made to derive an equation that can be used to predict this degrading effect quantitatively. This study is based on one-detector measurements but is equally appropriate to two-detector cross-correlation measurements. Equations derived to give insight into the behavior of ionization chambers operating in high gamma environments have led to the experimental development of a relatively low-cost, optimized chamber. (auth)

40591 AN INTRINSIC METHOD FOR DETERMINING ABSOLUTE THERMAL FLUX AND POWER IN HETEROGENEOUS REACTORS. Goring, G. E. (Trinity Univ., San Antonio, Tex.). Nucl. Sci. Eng., 29: 180-8(Aug. 1967).

Established techniques for measuring thermal reactor flux and power which utilize, respectively, arbitrary placement of foils and overall heat balance, have limited accuracy and are difficult to apply. A method based on ^{135}Xe accumulation plus a set of relative flux factors taken over the entire core instead of only at isolated positions is described. The technique involves only routine operating data, and required calculations are quite manageable by machine computation. After development of the theory, application is illustrated using a set of data from the Union Carbide Nuclear Company research reactor at Tuxedo, New York. Results are quite reliable when rod positions during the shutdown period are used, but operating period ratios introduce large inaccuracies by magnification of routine imprecision in operating data. It is concluded that the method offers an easily obtainable check on the usual heat-balance information for heterogeneous reactors, particularly if applied to shutdown data or to a xenon equilibrium run. (auth)

40592 VAPORIZATION OF FISSION PRODUCTS FROM IRRADIATED FUELS. I. EXPERIMENTAL METHOD AND GENERAL FISSION-PRODUCT BEHAVIOR. Castleman, A. W. Jr.; Tang, I. N. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 29: 159-64(Aug. 1967). (BNL-10546).

The results of an experimental study of the behavior of fission products released from metallic U and a U-3.5% Mo alloy into He and air are reported. A thermochromatographic technique for investigating the nature of low-concentration gas species is described and applied to the release of Ba, La, Ce, and Mo from irradiated fuels. Ba, La, and Ce, which deposit at high temperature in He, are not significantly released into air because of the low volatility of their respective oxides. Mo, which is quite nonvolatile in He, is released as MoO_3 in air. A list of 13 references is included. (auth)

40593 SOLUTIONS OF THE TIME-DEPENDENT ONE-GROUP DIFFUSION EQUATIONS FOR REFLECTED SYSTEMS. Sher, Rudolph (Stanford Univ., Calif.). Nucl. Sci. Eng., 29: 302-5(Aug. 1967).

A solution of the one-group diffusion theory in space and time is presented for the interpretation of pulsed neutron data. A cursory comparison of the various analytical techniques is given. The solution to the pulsed-neutron problem is obtained as a set of orthogonal eigen functions of the Sturm-Liouville problem. A sample calculation for a ^{235}U-H core, which is pulsed at its center and surrounded by a graphite reflector, is given. (M.L.S.)

40594 THE MISMATCH OF THERMAL AND EPITHERMAL NEUTRON FLUX. Cady, K. B.; Kirouac, G. J.; McInerney, J. J. (General Electric Co., Schenectady, N. Y.). Nucl. Sci. Eng., 29: 299-302(Aug. 1967). (KAPL-P-3143).

An investigation of the mismatch of thermal and epithermal fluxes is described. A model for correcting slowing down calculations by treating hydrogen in water as a mass-one gas is used. The results, using spherical harmonic kernels for the epithermal hydrogen cross-section, are compared with asymptotic slowing down calculations. 11 references. (M.L.S.)

40595 BUCKLING MEASUREMENTS IN WATER-MODERATED AND -REFLECTED EXPONENTIAL EXPERIMENTS. Windsor, Henry H. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 29: 296-8(Aug. 1967). (BNL-10621).

A model for use in the calculation of buckling for a water-moderated water-reflected reactor is given. This model is based on a modified one-group two-region representation of reflector savings for infinitely reflected cores. A comparison of this model with the flux-shape and variable loading models is presented. 11 references. (M.L.S.)

40596 INTERPRETATION OF PULSED-SOURCE EXPERIMENTS IN THE PEACH BOTTOM HTGR. Preskitt, C. A. (Oak Ridge National Lab., Tenn.); Nephew, E. A.; Brown, J. R.; Van Howe, K. R. Nucl. Sci. Eng., 29: 283-95(Aug. 1967). (ORNL-TM-1646).

A general description of pulsed-source experiments is developed from the time-dependent reactor equations. The interpretation of experiments is discussed, taking into account differences in shape and spectrum between the fundamental prompt and delayed modes, and the influence of prompt and delayed harmonic modes. Pulsed-source data obtained during the zero-power commissioning program of the Peach Bottom reactor are interpreted in terms of reactivity. Using an inhour analysis, good accuracy is obtained by incorporating detailed calculations into the interpretation. It is shown that the space-dependent variation of the reactivity deduced from modified pulsed-source techniques may exceed a factor of 10 in systems like the Peach Bottom reactor. 21 references. (auth)

40597 STATE VARIABLE FEEDBACK CONTROL OF MULTI-REGION REACTORS. Weaver, Lynn E.; Vanasse, Robert E. (Univ. of Arizona, Tucson). Nucl. Sci. Eng., 29: 264-71(Aug. 1967).

An approach to reactor control that is a result of modern control theory is presented, and is based on the control philosophy of feeding back all the state variables through constant gain elements. The values of these elements or feedback coefficients depend upon the desired system dynamics which is specified in terms of the system transfer function. Through state variable feedback design, the desired system dynamics can be realized exactly. Simulation studies have shown that, for the models considered, the sensitivity of parameter variations with respect to system dynamics was relatively low. Since this method depends on feeding back all the system variables, it is particularly amenable to the control of multiregion reactors. With the recent emphasis on spatial kinetics, this method of reactor control is the logical next step. Consideration is given to the case when all the state or system variables are not available for measurement. (auth)

40598 SPECTRUM AND IMPORTANCE FUNCTION IN SPATIALLY INDEPENDENT FAST-REACTOR ASSEMBLIES. Stacey, Weston M. Jr. (Massachusetts Inst. of Tech., Cambridge). Nucl. Sci. Eng., 29: 254-63(Aug. 1967). (KAPL-P-3182).

Analytical expressions for the spatially independent spectrum and importance (adjoint) function in fast-reactor assemblies have been developed. These expressions were obtained by solving the neutron balance equation, and the equation adjoint thereto, by the method of successive approximation. Solutions obtained in this manner suggest an interpretation of the collision density in terms of the probability that a fission neutron suffers a given sequence of scattering collisions, summed over all such sequences. Similarly, the importance function is interpreted in terms of the fission-neutron production probability following a given sequence of scattering collisions, summed over all such sequences. The analytical expressions are readily evaluated using either differential or group-averaged cross-section values. Integral properties of highly enriched and dilute fast-reactor assemblies were evaluated and compared with experiment; the agreement was comparable with that obtained with multigroup calculations normally employed to evaluate such assemblies. 19 references. (auth)

40599 POWER AND THE CHEMICAL INDUSTRIES: PARTNERS IN PROGRESS. Hines, Edward; Wagner, Harvey A. (Detroit Edison Co.). Chem. Eng. Progr., Symp. Ser., 63: No. 71, 3-7(1967).

Various aspects of the present trend toward production of cheaper electrical power from nuclear power plants are discussed. The impact of the lower power costs on the chemical industry are considered. Closer cooperation and more careful examination of possible collaboration between the electrical and chemical industries in the production and use of power are advised. (B.L.M.)

40600 COUPLED REACTOR KINETICS. Proceedings of the National Topical Meeting held at Texas A and M University, College Station, Texas, January 23-24, 1967. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967. 568p. (CONF-670107).

Various approaches to the solution of the kinetics of coupled-core systems are presented. Some experimental data are included. Separate abstracts are prepared for 22 of the 30 papers presented.

For remainder of papers see NSA abstracts 21:17511, 21:17456, 21:19365, 21:30132, 21:17458, 21:17457, 21:23725, and CONF-670107-7. (M.L.S.)

For abstracts of individual papers see: 40601–40617, 40657–40659, 40683, and 40684.

40601 INTERNATIONAL COOPERATION AND THE CONTROL OF NUCLEAR ENERGY. Keepin, G. R. pp 3–10 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

A survey of the interactions of nuclear energy and international diplomacy is presented. A plan for international cooperation for control of nuclear energy is given. (M.L.S.)

40602 TRANSFER FUNCTIONS AND RESPONSE FOR COUPLED CORE REFLECTED SYSTEMS. Hopkins, G. C. (Purdue Univ., Lafayette, Ind.); Adler, F. T. pp 42–60 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

A unified approach to spatial and spectral effects in multicore reactor systems is presented in the form of a generalized matrix transfer function. The methods of solution to the integro-difference equations are discussed. These solutions indicate that, under suitable conditions, a subcritical system consisting of two subcritical parts and excited by a neutron pulse may have a response which can be characterized as a damped oscillation, which is due to delay time effects. 11 references. (M.L.S.)

40603 AN ATTEMPT OF APPLYING COUPLED REACTOR THEORY TO TIME-DEPENDENT MULTI-REGION SYSTEM. Komata, Masaoki (Hitachi Ltd., Tokyo). pp 129–53 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

Multinode kinetic theory is applied to a time-dependent system. A one group diffusion model and a nodal are examined. The system is assumed to be perturbed stepwise from a steady state position. Delayed neutrons and diffusion coefficient time-dependence are, generally, neglected. Differential relationships between the diffusion and nodal models are obtained for various quantities. One case involving delayed neutrons and time-dependent coefficients is discussed. 12 references. (M.L.S.)

40604 STUDY ON THE SPACE DEPENDENT REACTOR KINETICS. Ebizuka, Yoshie; Furuichi, Kenji; Saito, Kazuya; Shindo, Masuo (Tokyo Inst. of Tech.). pp 154–66 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

The dynamic behavior of coupled reactors is described in terms of space-dependent kinetics. This is applied to fast power breeder reactors. The coupling is provided by leakage of neutrons, thus allowing definition of individual neutron flux distribution and reactivity for each component reactor. The reactor system is considered, particularly, from the aspects of stability and safety. The mathematical approach used is the linear vector matrix differential equations without internal feedback from the system. 7 references. (M.L.S.)

40605 APPLICATION OF INVARIANT IMBEDDING METHOD TO COUPLED REACTOR KINETICS. Kawai, Toshio (Hitachi Ltd., Ozenji, Japan). pp 167–75 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107

Coupled reactor kinetics is treated by the invariant embedding method. The reactor is considered to be composed of several blocks whose response to incident neutron current is separately known. Response is linear and stationary, so long as linearization of the response matrix is valid. Behavior of the system is obtained by synthesizing the response. (M.L.S.)

40606 NEUTRON TRANSPORT AND KINETICS IN A REACTOR COMPOSED OF TWO LOOSELY COUPLED CORES. Belleni-Morante, A. (Univ., Florence). pp 176–91 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

Reactor coupling equations, arising from the transport equation, are treated. A transport equation and its adjoint are used as basics; kinetics equations, the unknown functions of which are suitable adjoint weighted neutron populations, are derived. 15 references. (M.L.S.)

40607 SUMMARY OF DERIVATIONS OF COUPLED POINT REACTOR KINETICS EQUATIONS. Kohler, W. H. (Texas A and M Univ., College Station). pp 192–217 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

Point reactor kinetics for coupled systems are treated from the reactivity-coupling aspects. Reactivity-coupling of systems such as KIWI, Argonaut reactors, fast breeders, and fast–thermal STARK experiments are discussed. Use of point reactor kinetics for both highly coupled systems and weakly coupled systems is discussed. 20 references. (M.L.S.)

40608 NUMERICAL ANALYSIS OF PHYSICALLY REALISTIC COUPLING MODELS. Gage, S. J. (Univ. of Texas, Austin). pp 230–48 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

Coupled-core kinetics are formulated from the macroscopic nodal approach. This method takes into account the time distribution function for the coupling neutrons and the effects on prompt reactor kinetics. Four models for synthetic time distribution functions are given. Sample computations for these models are presented. 10 references. (M.L.S.)

40609 THE APPLICATION OF THE CALCULUS OF VARIATIONS AND THE METHOD OF GREEN'S FUNCTION TO THE SOLUTION OF COUPLED CORE KINETICS EQUATIONS. Carter, Neal; Danofsky, Richard (Iowa State Univ., Ames). pp 249–69 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

Solution to the coupled core kinetics equations is presented in the form of a space-time modal analysis in terms of neutron flux. The flux is expanded in a series of space dependent functions having time dependent expansion coefficients. Sample calculations, utilizing the method, are given. 4 references. (M.L.S.)

40610 DYNAMIC STABILITY OF COUPLED-CORE REACTORS WITH TEMPERATURE AND XENON FEEDBACK. Gage, S. J.; Malan, G. F.; Stevenson, M. G. (Univ. of Texas, Austin). pp 323–47 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

Coupled-core stability with temperature and xenon feedback is investigated. Frequency response in the low to intermediate frequency range is calculated by a computer program. This program allows any desired number of feedback mechanisms, including any number of delayed neutron groups. Results of parametric studies of the system are presented graphically. 6 references. (M.L.S.)

40611 INHERENT NEUTRONIC SAFETY CHARACTERISTICS OF THE FAST MODULAR REACTOR CONCEPT. Heck, F. M.; Dyos, M. W.; Gunson, W. E. (Westinghouse Electric Corp., Pittsburgh). pp 348–59 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

Neutronic coupling between modules of a fast breeder reference core is considered. The emphasis is on the safety inherent in a modular core design. Each module is treated as a separate system, and the kinetics equations are assumed to be space-time separable. Reactivity sharing between modules is examined. Reactor response to ramp reactivity insertions is shown graphically. 4 references. (M.L.S.)

40612 KINETICS OF COUPLED THERMAL-FAST SPECTRUM POWER REACTORS. Pluta, P. R. (General Electric Co., San Jose, Calif.); Huebschmann, W. G.; Lill, G. W. pp 360-78 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23-24, 1967. See CONF-670107.

An exponential approximation to the solution of coupled-core kinetics is presented. This allows a rather simple evaluation of coupling parameters; results are given for representative coupled-core power reactor transients. Calculations take into account the effects of different delayed neutron properties associated with different fissile materials, reactivity feedback, different prompt neutron lifetimes in each region, and prompt critical excursions. 10 references. (M.L.S.)

40613 SPACE DEPENDENT EFFECTS ON FAST-THERMAL SYSTEM PARAMETERS. Kelber, Charles N.; Madell, John T. (Argonne National Lab., Ill.). pp 379-89 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23-24, 1967. See CONF-670107.

The relative magnitudes of various space dependent effects on the kinetic parameters of large modular cores are evaluated. Effects of reactivity changes are evaluated. A model, representing an excursion caused by introduction of voids into the Na coolant of the fast core, is evaluated. This model does not include feedback effects. 7 references. (M.L.S.)

40614 THEORY AND APPLICATIONS OF NEUTRON FLUCTUATIONS IN NUCLEAR REACTORS. Saito, Keiichi; Otsuka, Masuhiko; Taji, Yukichi (Japan Atomic Energy Research Inst., Tokyo). pp 420 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23-24, 1967. See CONF-670107.

Equations describing the kinetic response of reactors to perturbations are given. The basic equation applicable to reactor noise and probabilistic analysis is formulated. The fundamental assumption is that the macrostochastic variables characterizing the nuclear system obey the Markoffian random processes. (M.L.S.)

40615 SPATIAL EFFECTS MEASURED IN A BOILING WATER REACTOR WITH INTERNAL NUCLEAR SUPERHEATER. Stone, J. T. (Allis-Chalmers Mfg. Co., Milwaukee). pp 436-51 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23-24, 1967. See CONF-670107.

Spatial effects measurements on Pathfinder Power Reactor are discussed. A description of the reactor and instrumentation is given. Calculated migration areas for superheater and boiler are listed. Dynamic testing to determine the effects of large and small perturbations on superheater and boiler core is discussed. Reactor stability tests at all power levels are analysed. (M.L.S.)

40616 SPATIAL AND SPECTRAL COUPLING EFFECTS IN MULTICORE REACTOR SYSTEMS. Adler, F. T. (Univ. of Illinois, Urbana); Gage, S. J.; Hopkins, G. C. pp 521-56 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23-24, 1967. See CONF-670107.

A mathematical development of a spectral-spatial coupling for multicore reactors is presented. Neutron delay times described by a multi-energy group treatment. The method of solution to these resulting equations is outlined. 55 references. (M.L.S.)

40617 COUPLED CORE KINETICS. Godts, J. E. pp 557-9 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23-24, 1967. See CONF-670107.

A nonlinear model which accounts for fuel and coolant temperature feedbacks and fuel displacement feedback is described. The mathematical formulation of this model which is necessary for computer coding is given. The model and code developed from it are based on one group delayed neutrons. The code calculates amplitude and phase response of a coupled-core system. 6 references. (M.L.S.)

40618 NUCLEAR SAFETY. Volume 8, Number 4. Cottrell, Wm. B.; Jordan, W. H.; Blakely, J. P. (eds.). Contract W-7405-eng-26. One of the five Quarterly Technical Progress Reviews published for the Division of Technical Information, USAEC. Oak Ridge National Lab., Tenn., Summer 1967. 131p. GPO $1.00 Domestic, $1.20 Foreign.

The Nuclear Safety journal includes the following sections: operating experience feedback to designers and to other operating agencies; nuclear safety economics; review of the nuclear criticality safety topical meeting; fuel element performance; frequency-response testing; fission-gas behavior in fuel materials; safety-system design problems; some aspects of reliability in reactor instrument systems; air-cleaning systems as engineered safeguards in nuclear reactor containment; neutron dosimetry in radiation-damage studies of steel; disposal of low-level radioactive wastes into the oceans; dosimetry and exposures in nuclear accidents; practices in the disposal of radioactive wastes from fuel-fabrication facilities; progress summary of nuclear research and development projects. Separate abstracts are prepared for each of the above sections. (M.L.S.)

For abstracts of individual sections see: 39168, 39169, 39278, and 40619–40629.

40619 OPERATING EXPERIENCE FEEDBACK TO DESIGNERS AND TO OTHER OPERATING AGENCIES. Cox, J. A. (Oak Ridge National Lab., Tenn.). Nucl. Safety, 8: 299-315 (Summer 1967).

In studying operating safety problems, it is apparent that similar problems occur in different reactors and that most problems are of a rather minor nature compared with the maximum credible accident which has occupied the attention of designers. Although most operating problems are relatively minor, they are nonetheless troublesome and tend to be repeated in new facilities unless personnel with operating experience participate in the design. In the case of the High Flux Isotope Reactor, considerable attention was given to such problems, and operating experience to date indicates that these improvements have been very worthwhile. Some of the problems solved during the 23 years of operating experience with Oak Ridge National Laboratory research reactors are described. 36 references. (auth)

40620 NUCLEAR SAFETY ECONOMICS. Lane, J. A. Nucl. Safety, 8: 316-23(Summer 1967).

A review of recent literature indicates that costs of nuclear safety, although constituting an important part of total plant investment, do not in themselves present a serious barrier to the achievement of economic nuclear power. The costs of items designed to prevent or limit the accidental release of radioactivity, for example, are estimated at $8/kW(e) for a 600 MW(e) plant, and the cost of a "standard" containment structure adds another $8/kW(e). Costs of preventing atmospheric contamination from a coal-fired plant, however, range from $12 to $25/kW(e). Thus it appears that air-pollution control in a fossil-fuel plant is as costly as preventing the escape of radioactive material from a nuclear plant. A more serious cost problem associated with nuclear safety is that of remote siting of a nuclear plant to meet isolation-distance requirements. Remote sitting can add an equivalent of from $10 to $20/kW(e) to nuclear plant costs. The use of multiple containment instead of standard containment and the inclusion of other engineered safeguards, however, offers the promise of reducing isolation-distance requirements and associated costs. Such measures, moreover, are necessary in congested areas of the country where remote sites are unavailable. 15 references. (auth)

40621 REVIEW OF THE NUCLEAR CRITICALITY SAFETY TOPICAL MEETING. Smith, David R. (Los Alamos Scientific Lab., N. Mex.). Nucl. Safety, 8: 323-30(Summer 1967). (LA-DC-8490).

The American Nuclear Society topical meeting in Las Vegas in December 1966 on nuclear criticality safety is discussed, and several of the papers presented are reviewed. The 24 papers and two panel discussions dealt with many facets of criticality safety. An academic task force concluded that criticality safety should receive increased emphasis in nuclear engineering education curricula. Numerous statements by participants reflected discontent with overly conservative safety practices and concern with the public sensitivity to nuclear risk. There was a consensus that the incidence of criticality accidents has been exceptionally low. However, there were significant differences of opinion as to the proper attitude toward the control of nuclear hazards. (auth)

40622 FUEL-ELEMENT PERFORMANCE. Scott, J. L. Nucl. Safety, 8: 331-9(Summer 1967).

Fuel-element development work is now being directed primarily toward advanced converters and fast breeder reactors. With the technical feasibility of the coated-particle fuels for high-temperature gas-cooled reactors assured, emphasis is currently placed on innovations that will reduce fuel-cycle costs. Recent high-burnup data on mixed-oxide fuel pins for both advanced converter and fast breeder reactors have delineated better the formidable swelling and fission-gas-release problems at the high burnups required for economical fuel cycles. We can expect many new developments in oxide and carbide fuels at high burnups in the near future. 42 references. (auth)

40623 FREQÜENCY-RESPONSE TESTING. Kerlin, T. W. (Univ. of Tennessee, Knoxville). Nucl. Safety, 8: 339-45(Summer 1967).

Frequency-response testing is a convenient method for determining the dynamic behavior of a reactor system. A number of test signals are available for testing which offer significant advantages over the classical oscillator test. These signals are: multifrequency sine waves, square waves, multifrequency binary sequences, pseudorandom binary sequences, pseudorandom ternary sequences, pulses, and steps. These signals are described, and their important characteristics are compared. 30 references. (auth)

40624 FISSION-GAS BEHAVIOR IN FUEL MATERIALS. Carroll, R. M. Nucl. Safety, 8: 345-53(Summer 1967).

Recent publications that relate to the behavior of fission gas in fuel materials are reviewed. The migration and release of fission gas from solids presents a rather consistent pattern of isolated gas atoms moving comparatively swiftly by an interstitial process until trapped on a defect in the structure of the solid. The defect can be inherent to the solid, or it can be produced by radiation. Small clusters of gas atoms are also mobile. Recoil and knockout release occur at all temperatures, but the surface conditions and history of the fuel can have a strong influence on the amount of release by these mechanisms. The engineering approach to fission-gas pressure within a fuel element is reviewed. 51 references. (auth)

40625 SAFETY-SYSTEM DESIGN PROBLEMS. Anderson, J. L. Nucl. Safety, 8: 354-6(Summer 1967).

Safety systems for nuclear reactors have shown little, if any, improvement, although instrument components have undergone substantial changes. Some of the probable reasons for this situation include separation of the system designer and analyst, specifications based on instrument packages rather than on system requirements, and an inordinate concern with self-testing circuits and fail-safe concepts. Electrical and physical separation to provide independence of instrument channels, although difficult to achieve, continues to be vital to safety-system design. 22 references. (auth)

40626 SOME ASPECTS OF RELIABILITY IN REACTOR INSTRUMENT SYSTEMS. McLean, T. L. Nucl. Safety, 8: 356-9 (Summer 1967).

The field of reliability engineering grew as a necessary part of the development of the complex electronic systems used in military and aerospace installations and was expanded as a useful tool in operations research and system engineering. An examination of the sensitivity of reactor protection systems to various types of failures is one application of this technology. Other uses of reliability engineering include the comparison of systems and the development of higher reliability systems. Because component failure is not the leading cause of reactor accidents, reliability cannot become the singular champion of nuclear safety. There are, however, useful applications of reliability technology to the improvement of the safety, operability, and economics of nuclear power stations. 22 references. (auth)

40627 AIR-CLEANING SYSTEMS AS ENGINEERED SAFEGUARDS IN NUCLEAR REACTOR CONTAINMENT. Keilholtz, G. W. Nucl. Safety, 8: 360-70(Summer 1967).

The functions of air-cleaning systems, during normal reactor operations and as engineered safeguards, are reviewed with special reference to the retention of airborne radioactivity by high-efficiency particulate air (HEPA) filters and charcoal adsorbers under possible accident conditions. The combination of an HEPA filter for particles and an impregnated charcoal bed for gases seems to be generally accepted as the best available trapping system for fission products released from irradiated fuels. The dioctyl phthalate tests are satisfactory for in-place testing of the particulate retention efficiency of HEPA filters; the complete filter unit should also be tested for heat resistance and mechanical strength. 39 references. (auth)

40628 NEUTRON DOSIMETRY IN RADIATION-DAMAGE STUDIES OF STEEL. Robinson, G. C. Nucl. Safety, 8: 370-5(Summer 1967).

The state of the art of neutron dosimetry as applied to studies of radiation damage to light-water-reactor pressure-vessel steels is reviewed. The following aspects are covered: current dosimetry practice, influence of damage models on data assessment, problems pertaining to current practice, and the trend in effort to overcome the prevailing problems. A recommended course for future efforts to resolve dosimetry problems is presented. 35 references. (auth)

40629 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Nucl. Safety, 8: 392-407(Summer 1967).

The water reactor nuclear safety experiments in SPERT–III and SPERT–IV and in the Power Burst Facility are outlined. Rupture and cracking in primary piping for water reactors is discussed. The investigation of radial and nonradial nozzle connections in spherical shells is outlined. Development work on the PM-2A reactor vessel is reviewed. Analysis of data on reinforced openings in pressure vessels is discussed; effects of sudden blowdown on primary cooling systems are outlined. Metal-water reactions are analysed. The analytical description of a reactor accident is outlined. Fission product behavior under accident conditions is presented. Conditions discussed are: in-pile destruction of reactor fuels, transient reactor conditions, and accident release. The operation of the Nuclear Safety Pilot Plant is discussed; new air cleaning techniques are explained. A filter evaluation program is presented; the removal of organic iodides from containment atmospheres is discussed. The Containment Systems Experiment, LOFT program, behavior analysis of primary coolant system during blowdown, and reactor vessel melt-thrcugh studies are outlined. CERT tests and CRI activities are reviewed. 29 references are included on light-water reactor safety. The safety problems involved in Na-cooled systems are investigated; the study of steam-graphite reactions is outlined; boiling studies for Na-cooled reactors are discussed; fission product and contamination control and fast reactor containment are investigated. 3 references are included on Na-cooled fast reactors. Fission product behavior under accident conditions is included under gas-cooled reactor safety. Dispersion of radioactive aerosols and gases throughout the environment is outlined; 5 references are presented on this topic. Reactor operational and general nuclear safety studies are presented. AEC administrative activities are summarized. Regulatory actions for the following projects are given: Burlington Station (Docket 50-272), Diablo Canyon Power Station (Docket 50-275), Dresden Nuclear Power Station Unit 1 (Docket 50-10), Fast Flux Test Facility (FFTF), H. B. Robinson Unit 2 (Docket 50-261), Indian Point Unit 1 (Docket 50-3), Monticello Nuclear Generating Plant (Docket 50-263), Nuclear Merchant Ship Savannah (Docket 50-238), Palisades Nuclear Power Plant (Docket 50-255), Pathfinder Atomic Power Plant (Docket 50-130), Peach Bottom Atomic Power Station (Docket 50-171), Plum Brook Reactor Facility (Docket 50-30), Point Beach Nuclear Power Plant (Docket 50-266), Quad Cities Units 1 and 2 (Dockets 50-254 and 50-265), Turkey Point Units 3 and 4 (Dockets 50-250 and 50-251), Vermont Yankee Nuclear Power Station (Docket 50-271). 35 references are given on these actions. Changes in 10 CFR for the following parts are detailed: Part 50; Parts 1 and 2; Part 14; Parts 30 and 32; Parts 30, 40, 50, 70, 170; Parts 31 and 32; Part 50; and Part 150. 19 references are included to cover these actions. (M.L.S.)

40630 NUCLEAR TURBINE ASME TEST CODE INSTRUMENTATION. NIAGARA MOHAWK POWER CORP, NINE MILE POINT, 525 MW, UNIT 1. Hilke, J. L. (Niagara Mohawk Power Corp., Buffalo); Colwell, K. W.; Cotton, K. C.; Carcich, J. A. New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/PTC-4, 8p., $1.50. (CONF-661102-19). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

The proposed performance test on Niagara Mohawk Power Corporation's steam turbine operating in the Nine Mile Point nuclear power plant is described. The turbine is an 1800-rpm tandem-compound six-flow unit with steam reheat. The objective of the test is to determine overall steam-turbine performance relative to guarantee. (auth)

40631 METHOD OF PROTECTING ALUMINUM OR ALUMINUM ALLOY SURFACES. (to Institutt for Atomenergi). French Patent 1,343,139. Oct. 7, 1963. Priority date Nov. 22, 1961, Norway.

A method for improving the corrosion resistance of Al to make this metal suited for use in nuclear power reactors is reported. An Al alloy, containing 8 to 15% Si, 0.5 to 2% Ni, 0.2 to 1% Fe, 0 to 1.5% Mg, 0 to 0.5% Ti, and 0 to 0.5% Zr is coated with a Ni–P-alloy in a Na-hypophosphite bath. The coated Al is then heat treated at 450 to 600°C during 0.5 to 100 hr in a salt bath which contains KNO_3 or $NaNO_3$ and $NaNO_2$ or KNO_2 in a ratio of 0.9:1.1 to 1.1:0.9. This treatment removes P and causes the Ni to diffuse into the Al base, forming a surface layer of $NiAl_3$ or Ni_2Al_3. A layer of 5 to 30 μ gives sufficient protection. (NPO)

40632 APPLICATION OF PRESSURIZED WATER REACTORS TO COMBINATION POWER AND WATER PLANTS. Comtois, Wilfred H. (Westinghouse Electric Corp., Pittsburgh). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-25, 7p., $1.50. (CONF-661102–13). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

A description of a typical desalting and electric power combination plant is given along with basic cycles currently proposed. The economic characteristics of a particular nuclear heat source, the Pressurized Water Reactor, are presented and discussed. Combination-plant economics are then treated according to a prescribed set of rules. Significant trends are pointed out as an aid to understanding variations in plant economics which are sometimes seemingly contradictory. (auth)

40633 ENGINEERING A SATURATED STEAM TURBINE PERFORMANCE TEST FOR THE 450 MW SAN ONOFRE NUCLEAR GENERATING STATION. Ortega, Orlando J. (Southern California Edison Co., Los Angeles); Deming, N. R.; Goodell, J. H. New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/PTC-2, 24p., $1.50. (CONF-661102–25). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

The results of engineering work to permit a performance test for the 450 Mw San Onofre Nuclear Generating Station of the Southern California Edison Company and San Diego Gas and Electric Company are presented. This station incorporates a closed-cycle light-water reactor (PWR) as the steam supply to the turbine. The test provision has been designed in the absence of an approved ASME Power Test Code governing saturated steam turbines. Special problems involved in testing a saturated steam turbine are discussed. Locations of test points and methods of measurement are reviewed. Bases for selection of instrumentation are described. Expected accuracy and repeatability of the test and effects on turbine efficiency calculations are summarized. (auth)

40634 POWER REACTOR CONTROL-ROD SYSTEM OPERATING EXPERIENCE. Pomrehn, H. F. (Holmes and Narver, Inc., Los Angeles). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-15, 10p., $1.50. (CONF-661102–26). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

The control-rod system operating experience of five U. S. power reactors, Dresden, Yankee, Indian Point, Humboldt Bay, and Shippingport, is summarized. Emphasis is given to the safety and reliability aspects of control-rod system performance. Included in the control-rod system are the control-rod assembly, the drive mechanism, and the associated hydraulic and electrical auxiliary systems. Data sources are identified and experience information deriving from periodic testing, normal operations, and system maintenance is discussed and pertinent conclusions noted. A reliability model is suggested to permit quantitative assessment of system scram reliability and an example is carried out using data derived from the experience summary. (auth)

40635 EXPERIMENTAL CRITICAL HEAT FLUX MEASUREMENTS APPLIED TO A BOILING REACTOR CHANNEL. Matzner, B. (Columbia Univ., New York); Casterline, J. E.; Moeck, E. O.; Wikhammer, G. A. New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/HT-46, 11p., $1.50. (CONF-661102–23). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

Critical heat flux limits for closely spaced 19-rod bundle elements in forced flow boiling were found to vary with system pressure (500 to 1200 psia) and heated length (18 to 108 in.). The data are consistent with those of others taken with close rod spacing. A specific correlation of the Macbeth form was obtained and applied to the CANDU-BLW-250 reactor channels. The advantages and limitations of this approach are discussed. (auth)

40636 SELECTION OF DESIGN AND OPERATING THERMAL AND HYDRAULIC LIMITS FOR BOILING-WATER REACTORS BASED ON PROBABILITY EVALUATION OF REACTOR PERFORMANCE. Richardson, L. S.; Trocki, T. (General Electric Co., San Jose, Calif.). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-18, 6p., $1.50. (CONF-661102–28). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

An analysis of the accuracy in evaluating minimum critical heat-flux ratio (MCHFR) in a BWR based on the measurement and calculational uncertainties in the individual variables affecting MCHFR; the observed frequency of operational overpower transients in ten reactor years operational experience of existing General Electric BWR's; and a technique for combining these effects to determine the probable frequency of exceeding the critical heat flux are presented. (auth)

40637 DECONTAMINATION OF THE SHIPPINGPORT ATOMIC POWER STATION. Saltarelli, E. A. (Westinghouse Electric Corp., West Mifflin, Pa.). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-6, 9p., $1.50. (CONF-661102–29; WAPD-T–1912). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

The Shippingport Atomic Power Station was decontaminated in conjunction with a modification program on the plant. The primary objective of the decontamination was to reduce radiation levels which had built up during the 67 months of operation. Decontamination was initiated on February 29, 1964 and completed on March 14, 1964. No major problems were encountered. Surveys taken before and after decontamination indicate that the decontamination was a success. The reduction of radiation levels permitted the modification program to be completed without any delays caused by radiation exposure. (auth)

40638 PROGRESS IN BOILING WATER REACTORS. Elliott, Vorras A. (General Electric Co., San Jose, Calif.). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-PWR-6, 10p., $1.50. (CONF-660952–2). DTIE.

From IEEE–ASME Power Generation Conference, Denver.

The progress made in the design of boiling water reactors and power plants during the past 11 years is discussed. The present-day boiling water reactor is the result of a deliberate and thorough program of engineering development and plant operation—planned to push the BWR to the point of competitive economics and widespread customer acceptance. (auth)

40639 FAST BREEDER POWER REACTOR DEVELOPMENT IN THE UNITED KINGDOM. Frame, A. G. (United Kingdom Atomic Energy Authority, Risley, Eng.). 17p. (CONF-660926–5). DTIE.

From International Nuclear Industry Fair and Technical Meetings, Basel.

Progress of fast reactor development program in the United Kingdom and areas for future development studies is presented. Construction and operation progress of the Dounreay Fast Reactor to the Prototype Fast Reactor development and design is also presented. (D.C.C.)

40640 PROGRESS AND ECONOMICS IN HIGH TEMPERATURE GAS-COOLED REACTOR SYSTEMS. Fowler, W. D.; Rickard, C. L.; Stewart, H. B. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). New York, Inst. of Electrical and Electronics Engineers, 1966, Preprint No. 31 PP 66-541, 9p., $1.00. (CONF-660952–3). DTIE.

From IEEE–ASME Power Generation Conference, Denver.

Research and development has continued to move the technology of gas-cooled reactors forward rapidly by going to higher temperatures, more effective fuel utilization and more efficient operation to yield minimal costs for power generation. The present advanced state of this development is represented by the High Temperature Gas-cooled Reactor (HTGR). The HTGR is characterized by the use of inert He gas as the primary coolant, graphite as the structural material for the fuel-moderator elements and a ^{235}U–^{232}Th fuel cycle. These basic elements provide primary system temperatures compatible with modern, high efficiency power plant operation and provide effective neutron utilization resulting in low fuel cycle costs. The prototype of this class of reactor, constructed at Peach Bottom, Pennsylvania, has completed its low power nuclear testing and is being readied for power operation. The first commercial sized HTGR, the 330 MW(e) unit to be constructed for Public Service Company of Colorado is scheduled for completion in 1970. Design work is going forward on other HTGR plants of larger capacity in the 600 MW(e) to 1000 MW(e) range. (auth)

40641 METHOD OF GAS PURIFICATION. (to Siemens-Schuckertwerke A.G.). French Patent 1,430,099. Jan. 24, 1966. Priority date Mar. 20, 1963, Germany.

An oxidation–reduction method for the continuous regeneration of a reactor coolant gas (He, CO_2) is described. The gas is passed through a bed of CuO and Cu particles held at 150 to 800°C. A gas sample taken from the bottom side of the bed is sent to a control apparatus, which regulates the proper addition of O_2, CO, and/or H_2 to the inflowing gas. (NPO)

40642 ELECTRICAL SYSTEM REQUIREMENTS FOR PRESSURIZED WATER REACTORS. Cooney, R. J. (Westinghouse Electric Corp., Pittsburgh). New York, Inst. of Electrical and Electronics Engineers, 1966, Preprint 31 PP 66-542, 5p., $1.00. (CONF-660952-1). DTIE.

From IEEE–ASME Power Generation Conference, Denver.

The auxiliary electrical load requirement for Westinghouse pressurized water reactor generating stations and the operation of the electrical system for various startup and emergency shutdown conditions are discussed. Included is a brief discussion of typical reactor trip circuits and emergency power supply for engineered safeguards systems. (auth)

40643 SEED-BLANKET NEUTRONIC REACTOR. Diener, R. L. (to U. S. Atomic Energy Commission). U. S. Patent 3,335,060. Aug. 8, 1967.

A seed-blanket reactor wherein the reactivity control is effected by the movement of tapered seed portions relative to fixed oppositely tapered seed portions and fixed blanket is described. (AEC)

40644 METHOD OF OPERATING A BREEDER REACTOR. Winsche, W. E.; Levine, M. M. (to U. S. Atomic Energy Commission). U. S. Patent 3,335,061. Aug. 8, 1967.

A method of operating a breeder type nuclear fission reactor is presented. The fuel, which contains mixtures of both fissile and fertile materials, is manipulated to bring fuel of increased fissle content into regions of greater reactivity effect. (AEC)

40645 RADIATSIONNAYA VEZOPASNOST' NA YADERNYKH REAKTORAKH. (Radiation Safety in Nuclear Reactors). Sivintsev, Yu. V. Moscow, Atomizdat, 1967. 640p.

The standards for radiation safety in nuclear reactors are reviewed in detail. The maximum permissible radiation levels are outlined. Methods used for the dosimetry of external radiation and the shielding necessary are given. The retention of fission products in the fuel and primary coolant of nuclear reactors is discussed. The precautions required for radioactive gases and aerosols in reactors are described. Methods used for measuring the internal radiation of reactors are given. (J.S.R.)

40646 ELEMENTARY REACTOR PHYSICS. Grant, P. J. Oxford, Pergamon Press, 1966. 196p. 30s.

The subject is treated under the following sectional headings: neutron flux and neutron cross-sections, neutron diffusion, slowing down of neutrons, the homogeneous reactor, the heterogeneous reactor, effects of temperature and of fission products, long-term changes, and control rod calculations. Appendixes include: useful constants, nuclear data, data for Westcott effective cross-sections, and solutions of the age equation. (UK)

40647 IMPROVEMENTS IN NUCLEAR REACTORS AND METHOD OF OPERATION SAME. (to Babcock and Wilcox Co.). French Patent 1,391,218. Jan. 25, 1965. Priority date Feb. 28, 1963, United States.

A single phase compressible moderating fluid capable of a substantial change in density with a change in temperature of the fluid is used to both cool and control a fast reactor. The system is stable and self-regulating and provides a high breeding ratio and a high fuel life. By utilizing a moderating fluid such as H_2O or D_2O steam, or a combination of the two, it is possible to control reactivity by varying the neutron energy spectrum in the core. This in turn changes the ratio of the number of fissions to the number of neutrons captured in fertile material within the core, the average energy of neutrons causing fission, and leakage of the neutrons from the core. These effects are produced by varying the concentration of the moderating fluid within the core or varying the mixture of fluids having different moderating power. In the operation of the system, the reactor tends to be self-regulating, increasing power to match an increase of the external load and decreasing power to match a decrease of the external load. (IIB)

40648 NUCLEAR REACTOR WITH BUILT-IN HEAT EXCHANGER. Legrand, Pierre. French Patent 1,390,156. Jan. 18, 1965. Filed Jan. 19, 1962.

The heat exchanger and the reactor of a nuclear power plant are contained in a common enclosure surrounded by an air-tight concrete structure partly embedded in the ground. A screen is provided within the chamber to prevent the radiation emitted from the nuclear reactor from striking the heat exchanger. The screen permits the passage of hot gases to the exchanger and a return of cooled gases therefrom. (NPO)

40649 IMPROVEMENTS RELATING TO NUCLEAR REACTORS AND THEIR CONTROL. (to Babcock and Wilcox Co.). French Patent 1,395,504. Mar. 8, 1965. Priority date Apr. 7, 1960, Germany.

The reactor has a control element with a closed tube extending into the reactor core. The tube contains material of high microscopic thermal neutron absorption cross-section (380 barns or more). The vapor density of this material varies in accordance with the temperature within the core to control the reactivity of the core and maintain the temperature of the core at a predetermined operating value. (NPO)

40650 COMPUTATIONAL TECHNIQUES AND RESOURCES. Clark, Hugh K. (E. I. du Pont de Nemours and Co., Aiken, S. C.). 20p. (CONF-661206-1; DP-MS-66-70). DTIE.

From American Nuclear Society, National Topical Meeting, Nuclear Criticality Safety, Las Vegas, Nev.

The types of problems in nuclear criticality safety where computations are necessary, the requirements of a computational technique, the needed parameters for calculation, and approximations for simplification of the computation are presented. (D.C.C.)

Rocket and Space Reactors

40651 (ANL–7290, pp 123-38) ARGONNE NUCLEAR ROCKET PROGRAM. (Argonne National Lab., Ill.).

A summary of developments in the Argonne Nuclear Rocket Program, terminated in July 1966, is presented. The unclassified parts of the design for a 10,000-lb-thrust system are summarized. Structural mechanics test facilities and analytical models are discussed briefly. The analysis of thermal stresses in fuel element coolant channels is outlined. The design of a multipurpose high-temperature model testing furnace facility, which was under construction at termination, is presented. (M.L.S.)

40652 (NASA-TN-D-4127) HEAT- AND MASS-TRANSFER CHARACTERISTICS OF AN AXIAL-FLOW LIQUID-CORE NUCLEAR ROCKET EMPLOYING RADIATION HEAT TRANSFER. Ragsdale, Robert G.; Kascak, Albert F.; Donovan, Leo F. (National Aeronautics and Space Administration, Cleveland, Ohio, Lewis Research Center). Aug. 1967. 46p. CFSTI.

An analysis of heat- and mass-transfer processes was conducted for a liquid-core nuclear rocket engine that employs radiation heat transfer. A liquid carbide fuel was supported on the inside surface of a rotating tube. The hydrogen propellant, seeded with radiation-absorbing seed material, flowed through the tube where it was heated by thermal radiation from the fissioning liquid fuel. Liquid-fuel surface temperature, U concentration in the fuel, tube length and diameter, and H_2 flow rate were the primary variables. Calculations were made for both ZrC and NbC solvents in which UC was dispersed. The calculations show that radiant heating produces a specific impulse somewhere between the lowest value of interest, 1300 seconds, and the maximum attainable, about 1600 seconds—a value that is only marginally higher than that provided by conduction heating of H_2 bubbled through the liquid fuel. The ratio of H_2 flow rate to U flow rate is from about 20 to 100, depending on flow-rate ratio, reactor pressure, tube diameter, and thrust to core-weight ratio. The thrust to core-weight ratio is between 3 and 13. The surface temperature of the liquid fuel must be maintained between 9000 and 10,000°R in order to attain a specific impulse in the range of interest. (auth)

40653 (NP–16954) EVALUATION OF METHODS FOR COMPUTING NUCLEAR ROCKET RADIATION FIELS. (Lockheed–Georgia Co., Marietta, Ga.). [1965]. Contract NAS8-9500. 119p. (ER–8236).

A critical evaluation of pertinent computer programs, emphasizing usefulness in future analysis and design of nuclear rocket systems, is presented. The computer programs discussed include: point-kernel programs 14-0 (and 14-1), QAD-PS (and QAD-IV), and C-17; discrete ordinates programs DDK and DTK; and Monte Carlo programs 18-0, MCS and MCG, O5R, and COHORT. (D.C.C.)

40654 (SAN–679-3) DESIGN STUDY [OF] ELECTRICAL COMPONENT TECHNOLOGY FOR 0.25 TO 10.0 MEGAWATT SPACE POWER SYSTEMS. Quarterly Technical Progress Report No. 3. King, A. E. (ed.) (Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.). May 31, 1967. Contract AT(04-3)-679. 93p. Dep. CFSTI.

Parametric studies to determine minimum system weight as a function of electrical component rating, voltage, frequency, and speed are presented on ac generators, ac motors, power conditioning, and power distribution equipment for 0.25 to 10.0 megawatt space nuclear electric power plants utilizing the Rankine

conversion cycle. The power conditioning and distribution equipment includes transformers, rectifiers, frequency changers, contactors, and transmission lines. Concluding parametric data are presented for the electrical system components listed. Electrical power systems are presented to illustrate electrical load breakdown on probable missions requiring 0.25 to 10.0 megawatts of power. Experiments to verify analytical techniques for inductor generator designs typical of high-power, high-speed, high-frequency, high-temperature applications are presented. (auth)

40655 (SC-DC-67-1916) MODERN CONTROL APPLICATIONS TO NUCLEAR PROPULSION. Mohler, Ronald R. (New Mexico Univ., Albuquerque). July 1967. Contract AT(29-1)-789. 15p. (CONF-670710-3). Dep. CFSTI.

From American Astronautical Society Symposium, Denver, Colo.

Fuel-optimal control of a nuclear propulsion system is analyzed by means of the maximum principle, Lagrange multipliers and computers. Practical problems are shown to be most complicated by state constraints and high dimensionality. The optimal policy, a maximum allowable effort type of process, requires a time-optimal reactor control policy. With this in mind, a minimal-time, prompt-neutronic control process with reactivity rate and amplitude constraint is analyzed. (auth)

40656 (UCID-15191) MATERIALS ASPECTS OF ^{233}U, ^{235}U, AND ^{239}Pu FOR THE SPACE POWER REACTOR. Kane, J. S. (California Univ., Livermore. Lawrence Radiation Lab.). Nov. 1, 1966. Contract W-7405-eng-48. 4p. Dep. CFSTI.

The relative merits of ^{233}U, ^{235}U, and ^{239}Pu are considered from the aspect of materials properties for their use in high-temperature nuclear reactors. Failure mechanisms for reactor fuels are reviewed. In general, the compounds of Pu are not as "refractory" as those of U. In interstitial type compounds, the stability comes at least in part from metal–metal bonding, and this is weaker for Pu than for U. Both the melting points and the sublimation temperatures are lower for compounds of Pu than for U. Handling problems for Pu would increase research, development, and fabrication costs compared to ^{235}U. To handle ^{233}U safely, facilities similar to those used for Pu are necessary, with the added expense and complication of shielding and/or remote-handling equipment. (M.C.G.)

40657 COUPLED REACTORS IN NUCLEAR ROCKET APPLICATIONS. Johnson, Paul G. (AEC–NASA Space Nuclear Propulsion Office, Washington, D. C.). pp 11-28 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

The use of clustered reactors for space applications is discussed. Requirements of manned planetary mission requirements are given. Shielding problems involved in engine cluster are summarized. 3 references. (M.L.S.)

40658 CALCULATION OF INTERACTIONS BETWEEN CLUSTERED NERVA REACTORS. Mowery, Alfred L. Jr.; Romesburg, H. C. pp 64-76 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

Neutronic couplings between NERVA reactors are discussed. Efficiencies of these coupled cores are calculated; results are discussed. The shell-source technique and iterated fission probability methods for efficiency calculations are compared. 6 references. (M.L.S.)

40659 NEUTRONIC COUPLING AND ITS EFFECTS IN CLUSTERED NUCLEAR ENGINES. Woyski, Jan S. (Douglas Aircraft Co., Inc., Santa Monica, Calif.). pp 77-117 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

A method for calculating reactivity coupling effects for various types of propulsion reactors and in various cluster arrangements is discussed. The critical cluster, used for an example, consists of individually subcritical component reactors; reactivity coupling provides the coupling for criticality. The neutron leakage, neutron interception probability by another reactor, and the reactivity worth of incident neutrons are calculated. 25 references. (M.L.S.)

40660 TRANSIENT HEAT TRANSFER AND THERMAL STRESSES FOR A NUCLEAR ROCKET DUE TO SUDDEN INCREASE OF COOLANT FLOW. Shen, C. N.; Liu, T. C. (Rensselaer Polytechnic Inst., Troy, N. Y.). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-4, 10p., $1.50. (CONF-661102-30). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

The analytical solutions of the thermal transient and thermal stresses are derived for a sudden change of the coolant flow in a nuclear rocket. These solutions are suitable for two geometric configurations of fuel elements which are commonly encountered in nuclear-rocket design. (auth)

40661 THE TESTING OF NRX/EST AND NRX-A5. Davison, P. W. (Westinghouse Electric Corp., Pittsburgh). New York, American Institute of Aeronautics and Astronautics, 1966, Preprint No. 66-1004, 7p., $1.50. (CONF-661124-1). DTIE.

From 3rd AIAA Annual Meeting, Boston.

The primary objective of the NRX/EST test series was the testing of a "breadboard" nuclear rocket engine system using a hot bleed port nozzle. A secondary objective was a reactor duration test. The major accomplishments were: the demonstration of "bootstrap" start-up capability over a wide range of operating conditions to intermediate power and full power; the acquisition of data to validate and further develop analytical models of the engine control system; and operation at or above 3800°R chamber temperature for 27 minutes. The primary objective of the NRX-A5 test series was to determine the reactor duration capability. The major secondary objectives were to demonstrate the feasibility of a "no flux loop" temperature controller and a fixed control drum start-up from low to high power, and to measure more precisely the radioactive effluent discharged from the reactor. The total operating time at or above 3800°R chamber temperature and 71.3 lb/sec propellant flow rate was 29.4 minutes. During both full power operations, in-core temperature measurements were used to directly control the reactor power; the nuclear power instrumentation was used only for monitoring and safety (scram) functions. For the second power test, an engine-type neutronics system was used with special detectors located near the dome end of the pressure vessel and eight-decade (30 watts to 3,000 megawatts) log amplifiers. A fixed control drum start-up, i. e., power controlled by a programmed propellant flow rate ramp, was performed from 30 kilowatts to 720 megawatts for the second power test. Smoke from JATO units exhausted vertically about 200 feet from the test assembly was used successfully to mark the effluent cloud. (auth)

Process Heat and Desalination Reactors

Refer also to abstracts 38945, 39113, and 40632.

40662 (HW-78526(Vol.1)) SECONDARY COOLING SYSTEM SIMULATION STUDY. VOLUME 1. RESULTS AND CONCLUSIONS. Swezea, G. L. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). May 15, 1963. Contract AT(45-1)-1350. 109p. Dep. CFSTI.

Reactivity tests for Hanford-N reactor are discussed. Ramp and scram transients effects are evaluated. Coolant studies are presented. Control system evaluations are discussed. (J.C.W.)

40663 PROJECTED COSTS OF NUCLEAR POWER AND PROCESS HEAT. Bernsen, S. A.; Schmitz, R. P. (Bechtel Corp., San Francisco). Chem. Eng. Progr., Symp. Ser., 63: No. 71, 89-95(1967).

A review is presented of current trends in size and cost of nuclear electric power plants, and the significance of these developments to process heat users is explained. In addition, typical costs for single and dual-purpose plants and for steam produced utilizing them are considered. The size of the plant and capital charge rate are shown to have significant effect on the cost of thermal energy. Also, the value of by-product power has a major influence on the thermal energy cost for dual-purpose plants. Attractive thermal energy costs appear achievable for large dual-purpose nuclear plants. (auth)

40664 PROJECTED POWER COSTS FROM LARGE NUCLEAR DESALTING PLANTS. Sindt, H. A. (Atomic Energy Commission, Washington, D. C.); Spiewak, Irving; Anderson, T. D. Chem. Eng. Progr., Symp. Ser., 63: No. 71, 11-17 (1967).

As a result of the potential requirement for large nuclear reactors for power-desalting applications, conceptual design studies of 10,000 Mwt boiling-water, heavy water-moderated organic-cooled, high-temperature gas-cooled, and Na-cooled fast-breeder reactors were conducted. These studies indicated that extrapola-

tion to the large plant sizes considered should be practicable for each of the reactor concepts investigated. Power generation costs from such plants were estimated to range from 1.9 to 2.8 mills/kWh under private financing and from 1.0 to 2.0 mills/kWh under public financing. Reductions in power generating costs to these levels should result in favorable power prices to power consumers. (auth)

40665 NUCLEAR ENERGY AND WATER SUPPLY. Davis, W. Kenneth; Appleton, J. L. (Bechtel Corp., San Francisco). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-27, 11p., $1.50. (CONF-661102-14). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

A basis for evaluating the relative importance of large-scale nuclear desalination in a specific application and with favorable ground rules is presented. Large scale desalination is most economical in a dual-purpose combination with power generation. The choice between fossil or nuclear fuel as the energy source for desalination should be based on engineering and economic analyses relating to the particular site and size of steam unit required. In more and more places, where expanded water supplies are contemplated, desalination will be considered as an alternate source of supply. (auth)

40666 NUCLEAR REACTORS FOR SEA-WATER DESALINATION. Ma, Benjamin M. (Iowa State Univ., Ames). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-21, 9p., $1.50. (CONF-661102-22). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

Current and near-term converters, and long-range breeders for sea-water desalination are analyzed. The trends of current and near-term converters and the full utilization of U and Th energy resources in developing fast and thermal breeders are discussed. Comparisons of single-purpose and multipurpose nuclear desalting plants from economic and technological considerations are also given. (auth)

Research and Test Reactors and Critical Assemblies

Refer also to abstracts 39098, 39285, 39575, 40351, 40357, and 40536.

40667 (ABS-THH-1014) ABSCHAETZUNG DER BEI EINEM ABSCHIRMUNGSEXPERIMENT AM FR GEESTHACHT AUFTRETENDEN AKTIVITAETEN. **(Estimation of the Activity Occurring in the Geesthacht Research Reactor in a Shielding Experiment).** Stiller, G. (Technische Hochschule, Hanover (West Germany). Arbeitsgruppe fuer Bautechnischen Strahlenschutz). Mar. 1964. 17p. (In German). Dep.

The shielding arrangement of the irradiation channel of the Geesthacht Research Reactor is described. The activity of the individual components of the shield was estimated for irradiation times of 10, 30, and 900 min. The results are tabulated. The dose output for the steel plate was calculated as 3.5 r/hr in 1 m and 20 mr/hr in 1 m of boron steel plate. (J.S.R.)

40668 (ANL-7270) ANALYSIS OF HIGH CONVERSION CRITICAL EXPERIMENTS. Pennington, E. M. (Argonne National Lab., Ill.). Mar. 1967. Contract W-31-109-eng-38. 42p. Dep. CFSTI.

Critical experiments performed in the ZPR-7 facility using Hi-C or BORAX-V fuel and light-water moderator are analyzed. The Hi-C fuel consisted of 3.04 wt % enriched UO_2 pellets of 0.935 cm diameter, stacked to a height of 122 cm in either Al or stainless steel tubing. Experiments with BORAX-V fuel used UO_2 pellets, which were 4.95 wt % enriched, 0.871 cm in diameter, and stacked 61 cm high in stainless steel tubing. All lattices analyzed consisted of fuel rods uniformly spaced in either square or triangular arrays. The H-to-^{235}U atom ratios in the cores were calculated. Measurements extended far into the undermoderated region. Calculations of critical bucklings, reflector savings, and various microparameters are compared with experimental values. 31 references. (auth)

40669 (ANL-7290, pp 27-119) ARGONNE ADVANCED RESEARCH REACTOR (AARR). (Argonne National Lab., Ill.).

Design parameters for the AARR are tabulated. A complete description of the reactor facility is given. A summary of the available irradiation facilities in the AARR is presented. Thermal stresses in fuel plates are shown as a function of time. A summary of the cermet fuels burnup analyses is presented. Out-of-pile blister test data for AARR reference fuel plates is presented as a function of fission density. A summarization of burnable poison additions to prototype cermet fuels is given. A tabular summary of UO_2 particle characterization and evaluation studies is presented. Brazing of fuel plate subassemblies is discussed. Materials studies for fuel plates, control rod blades, and pressure vessels are summarized. Heat transfer analyses for beam tube facilities and jackets are given. Corrosion and compatibility studies for AARR materials are discussed in some detail. (M.L.S.)

40670 (ANL-7349, pp 110-14) ADVANCED SYSTEMS RESEARCH AND DEVELOPMENT. (Argonne National Lab., Ill.).

The contract for initial construction work on the Argonne Advanced Research Reactor was awarded, and the groundbreaking ceremony was held on June 12. A thermal analysis was completed on portions of the reactor-vessel internal structures. (H.D.R.)

40671 (AWRE-R-4/63) VERA ^{235}U-GRAPHITE REACTOR EXPERIMENT. Interim Report. McTaggart, M. H.; Goodfellow, H.; Paterson, W. J.; Weale, J. W. (Atomic Weapons Research Establishment, Aldermaston (England)). [nd]. 55p. Dep. CFSTI. UK.

Experimental work on a number of small fast reactor assemblies with U-235/graphite cores and natural U reflectors is presented. The object of the experiments was to provide detailed information against which the nuclear data for U-235 in the energy region from 500 to 50 keV could be checked. Critical masses were measured for five assemblies. (auth)

40672 (BMI-X-10200) MATERIAL AND FABRICATION SPECIFICATIONS FOR THE AARR FUEL PLATES. Lozier, D. E.; Kizer, D. E. (Battelle Memorial Inst., Columbus, Ohio). June 20, 1967. 29p. Dep. CFSTI.

Progress on fabrication of fully enriched 37% UO_2–stainless steel dispersion plates for the Argonne Advanced Research Reactor is reported. Subjects considered include chemical and physical properties of UO_2, ZrB_2, and stainless steel powders; standards for type 347 stainless steel bonding frames and cover plates, fabrication, and fuel plate inspection guides. It is concluded that procedures developed are adaptable to production facilities and can be used in production of satisfactory fuel plates. (P.G.C.)

40673 (BNL-11636) SAFETY ANALYSIS OF THE BROOKHAVEN NATIONAL LABORATORY CRITICAL ASSEMBLY FACILITY. Court, A.; Downes, K. W.; Kouts, H. J. C. (Brookhaven National Lab., Upton, N. Y.). Aug. 1, 1967. 182p. Dep. CFSTI.

Past experiments in the Brookhaven Critical Assembly Facility have been conducted with thermal neutron assemblies. A safety analysis is presented for submission with a proposed revision in the operating limits to include experiments with fast critical assemblies. The Facility site, buildings and cells, administration, and instrumentation and practices used to prevent the occurrence of criticality accidents are described. It is concluded that the Facility meets license standards with a substantial margin of safety. (H.D.R.)

40674 (GEAP-5294) ANALYSIS OF THE SEFOR MOCKUP CRITICAL EXPERIMENTS IN ZPR-3. Reynolds, A. B.; Stewart, S. L. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Mar. 1967. Contract AT(04-3)-540. 54p. Dep. CFSTI.

For Southwest Atomic Energy Associates.

A series of critical experiments were performed on a mockup of SEFOR at ZPR-3. Analyses of these experiments and the application of the results to the SEFOR design are discussed. Critical mass values were determined for 1-, 2-, and 3-segment SEFOR fuel designs to help establish the Pu atom fraction in the SEFOR fuel. Reactivity effects of axial fuel expansion were measured which led to selection of the 2-segment design for SEFOR. Measurements of the reactivity worth of the radial reflector established the adequacy of the SEFOR reflector control system. The Doppler coefficient was measured. The calculated ^{238}U Doppler coefficient was in agreement with the experiment; the measured ^{239}Pu contribution to the SEFOR Doppler coefficient was near zero. It was demonstrated that the SEFOR Doppler is significantly more negative than the conservative value assumed for safeguards analysis. The maximum positive reactivity caused by loss of sodium was measured; the measured reactivity was small (+6¢) and close to the calculated value. The ratio of prompt neutron lifetime to delayed neutron fraction was measured both by the pulsed neutron technique and by noise analysis. The values measured by the two techniques were in agreement. Fission ratios, fission and boron traverses, and Pu worth distributions were measured and are compared with calculations. (auth)

40675 (IN-1083) NUCLEAR TECHNOLOGY BRANCHES QUARTERLY REPORT, OCTOBER 1–DECEMBER 31, 1966. (Idaho Nuclear Corp., Idaho Falls). May 1967. Contract AT(10-1)-1230. 74p. Dep. CFSTI.

Progress is reported on several phases of nuclear technology. Self-shielding effects of B_4C particles of various sizes have been studied. A comparison of values obtained by (a) reactivity measurements in the ARMF and (b) first-flight transport calculations indicates that results obtained by the two methods agree well for particle sizes smaller than 85 microns. The self-shielding factor, f_p, for −325 mesh-size particles now being used in ETR and ATR fuel elements is 0.94. Insufficient fuel-plate to side-plate engagement was apparently the cause of premature failure of two ATR dummy fuel assemblies during the hydraulic proof test; whereas, inadequate swaging technique resulted in the failure of one fueled ATR fuel assembly during a similar test. Four other ATR dummy assemblies successfully withstood the hydraulic proof test although one was marginal in its performance. The fuel core width tolerances for the ATR fuel plates have been relaxed as a result of further investigations. A review of the allowable dogboning in MTR fuel assemblies has been completed, and the results are reported. Improvements in the response time of commercially available, sheathed, Type K thermocouples have been obtained by remaking the hot junctions using Cu and Ag rather than stainless steel. Post-operation measurements of the channel thicknesses of ETR fuel elements were made and are reported. Significant changes in these dimensions were observed. The results are given of an irradiation test program conducted for the Argonne Advanced Research Reactor. In this test, stainless steel clad plates fueled with UO_2 were irradiated in the G-12 pressurized water loop of the ETR at heat fluxes of 0.6 to 1.1×10^6 Btu/hr-ft^2 to exposures of up to 14.6×10^{20} fissions/cc. Post-irradiation examinations indicated that the samples were sound, that the fuel core swelling rates were lower than predicted, and that the failures produced by post-irradiation annealing were in good agreement with failure-no-failure data produced during irradiating testing by others on similar samples. Compatibility studies were made on tantalum, graphite, and Al_2O_3 with intermetallic fuel (UAl_x, U_3Si, or UCu_5) systems for the purpose of selecting a suitable heat transfer medium. Graphite appears to be most suitable. (auth)

40676 (KFK-579) SOME ASPECTS OF THE FEASIBILITY OF A 10^{16}-FLUX REACTOR. Dalle Donne, M.; Kallfelz, J.; Kuechle, M. (Kernforschungszentrum, Karlsruhe (West Germany)). June 1967. 35p. Dep.

A preliminary investigation was made to determine the engineering problems and economic implications of a $^{16}10$ flux reactor. A beam research reactor was taken as an example and calculations are made for an isotope reactor. The design included the annular core with a one ring HFIR-type fuel element, the Be plug in the center, and the pressure barrel between core and D_2O-reflector. Only the basic features of the reactor were studied and all calculations were made for a reactor without beam tubes. (J.C.W.)

40677 (NP-16991) CHEMICAL DOSIMETRY IN THE UTR 100 REACTOR. Scott, W. M. (Scottish Research Reactor Centre, East Kilbride (Scotland)). [1966]. 15p. (SRRC-16/67). Dep.

Dose rates have been measured in the large rabbit system, the small rabbit system and the central vertical stringer of the UTR-100 reactor using both ferrous sulphate and cyclohexane as dosimeters. A distinct variation in dose rate exists across the large rabbit, Fricke solution measurements indicating dose rates higher by a factor of 1.58 at the inner end compared to the outer end. The six irradiation positions in the small rabbit system are considered to be equivalent within the limits of experimental error. The higher dose rate in the central vertical stringer is attributed to the fact that this irradiation facility penetrates between the two fuel tanks and is thus in a region of higher fast neutron flux than is the small rabbit system. The dose rates measured using cyclohexane dosimetry are 3.39 Mrads/hr at the inner end and 2.31 Mrads/hr at the outer end of the large rabbit system, 2.37 ± .11 Mrads/hr in the small rabbit system and 4.50 ± 0.11 Mrads/hr in the central vertical stringer. (auth)

40678 (ORNL-P-3202) IN-PILE HEAT TRANSFER STUDIES OF ROUGHENED HELIUM-COOLED REACTOR FUEL ELEMENTS. Brandon, C. A.; Kidd, G. J. Jr. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 6p. (CONF-671102-2). Dep. CFSTI.

For Presentation at 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

Four reactor fuel elements were tested in LOOP No. 1 of the Oak Ridge Research Reactor for in-pile heat transfer data. Three of the elements were roughened surface and one smooth surface. The study shows that an increase in heat transfer can be obtained by the use of the types of surface roughness tested. (J.C.W.)

40679 (ORNL-TM-1962) HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT, JANUARY–MARCH 1966. McCord, R. V.; Corbett, B. L. (Oak Ridge National Lab., Tenn.). Aug. 24, 1967. Contract W-7405-eng-26. 29p. Dep. CFSTI.

During the quarter the HFIR operated at an appreciable power level for the first time. As operating experience accumulated and confidence in the machine developed, the power level was gradually increased to 20 MW. However, as the excessive downtime and unscheduled shutdowns indicate, the reactor was still in a "shakedown" and testing phase. Numerous minor, but aggravating, problems occurred. These problems and their solutions are discussed. (auth)

40680 (ORNL-TM-1963) HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT, APRIL–JUNE 1966. McCord, R. V.; Corbett, B. L. (Oak Ridge National Lab., Tenn.). Aug. 24, 1967. Contract W-7405-eng-26. 25p. Dep. CFSTI.

A power level of 75 MW was achieved. The first HFIR fuel element was burned out by an uninterrupted 18-day run at a power level of 50 MW following 1320 MWd of operation at 20 MW and less. This element produced 2229 MWd of power. Two major modifications were made to the reactor facility. Charcoal filters with a minimum 1½-in.-thick layer of charcoal were installed in the SBHE filter pits to replace the original filters which had only ½ in. of charcoal. Subsequent tests indicate that the iodine removal efficiency of the new filters is more than adequate to meet the design conditions assumed in the safety analysis. A poison-injection system utilizing $Cd(NO_3)_2$ was installed as an emergency backup for the normal reactor control system. (auth)

40681 (RCN-75) EXPERIMENTAL STUDY OF DIFFERENT TECHNIQUES FOR ANALYSING REACTOR NOISE MEASURED BY A NEUTRON COUNTER. Tuerkcan, Erdinc; Dragt, Jan B. (Reactor Centrum Nederland, Petten). June 1967. 35p. Dep.

Seven different techniques existing for the analysis of reactor noise measured by a neutron counter are experimentally compared. The same measurement was analyzed by means of a digital computer by determining Feynman's variance-to-mean ratio, Bennett's delta variance, the autocorrelation function, a special third order moment, and the probabilities for zero, one or an even number of counts (for the so-called p-methods, viz. p_0, p_1 and p_{even} respectively). All quantities were fitted to the theoretical expressions by the method of least squares, where in case of the first three types of analysis a correction for delayed neutrons and for finite measuring time was applied. The different types of analysis yield the same values for the two reactor parameters involved. Bennett's technique appears to be the most accurate one, although it is a bit sensitive to higher mode effects. It is the first time that results with the third order moment method and the p_1 and p_{even}-techniques are reported. The results are in good agreement with the theory. (auth)

40682 (RPI-328-99) EFFECT OF GROUP-CONSTANTS AVERAGING PROCEDURE ON FEW-GROUP REACTIVITY CALCULATIONS. Greenspan, Ehud (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science). [1966]. Contract AT(30-3)-328. 6p. (CONF-671102-6). Dep. CFSTI.

For Presentation at 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

The extent to which different reactivity coefficients may be affected by the averaging procedure and intercompares between the conventional, the bilinear, and a consistent averaging procedures are investigated. (J.C.W.)

40683 STUDY ON THE TRANSFER FUNCTION OF SHE CRITICAL ASSEMBLY. Wakabayashi, Jiro; Hoshino, Tsutomu (Kyoto Univ.). pp 421-35 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

Theoretical and experimental results of transfer function measurements in the Semi-Homogeneous Experiments Critical Assembly are presented. The two-group diffusion approximation is used for theoretical calculations. Coupling of averaged thermal and epithermal fluxes in the core and reflector is assumed. Thermal and epithermal flux measurements were made for validation of this assumption. (M.L.S.)

40684 MEASUREMENT OF THE REACTIVITY COUPLING COEFFICIENT IN THE IOWA STATE UTR-10. Hendrickson, Richard A.; Danofsky, Richard A. (Iowa State Univ., Ames). pp 506-20 of Coupled Reactor Kinetics. Chezem, C. G.; Koehler, W. H. (eds.). College Station, Tex., Texas A and M Press, 1967.

From American Nuclear Society, Coupled Reactor Kinetics Conference, College Station, Tex., Jan. 23–24, 1967. See CONF-670107.

A cross-spectral density method for obtaining the reactivity coupling coefficient of a coupled core reactor is developed. An experimental measurement of the ratio of the reactivity coupling coefficient to the mean generation time of neutrons in the core is described. 6 references. (M.L.S.)

40685 ACCURACY OF CROSS AND AUTO REACTOR NOISE SPECTRA. Dragt, Jan B. (Reactor Centrum Nederland, Petten). Nukleonik, 10: 95-6(July 1967).

Closed expressions are derived for the variances in auto and cross power spectral density estimates for equal measuring times, in a zero power point reactor. It is concluded that for large detector efficiencies and large bandwidth the auto power spectrum is slightly more accurate, but for low efficiency and restricted bandwidth the cross power spectrum is superior. (auth)

40686 SUBCRITICAL REACTIVITY FROM NEUTRON STATISTICS. Lindeman, Arthur J.; Ruby, Lawrence (Univ. of California, Berkeley). Nucl. Sci. Eng., 29: 308-10(Aug. 1967).

Results of subcritical reactivity measurements in the AGN-201 reactor are tabulated. Statistical evaluation of the data is presented; comparison between the fitting of neutron distribution data with a negative binomial and Poisson distribution is discussed. (M.L.S.)

40687 A PROCEDURE FOR EVALUATING MODIFIED PULSED-NEUTRON-SOURCE EXPERIMENTS IN SUBCRITICAL NUCLEAR REACTORS. Masters, Christopher F.; Cady, K. B. (Cornell Univ., Ithaca, N. Y.). Nucl. Sci. Eng., 29: 272-82 (Aug. 1967).

A theoretical interpretation of the modified pulsed-neutron-source experiments of Sjostrand, Gozani, and Garelis and Russell is given using exact steady-state Boltzmann equations. The interpretation is based on a phenomenological description of the experiments and is patterned after work done on the Garelis-Russell method by Corngold. The basic approximation made is that the fundamental prompt-mode decay constant is much larger than any delayed-neutron precursor decay constant. The theoretical interpretation allows the reactivities measured by the above three modified pulsed-source techniques to be easily calculated and compared to more conventional definitions of reactivity. The calculations can be performed by any standard source-iteration code that has been modified to solve the inhomogeneous problem. Experiments were performed on the Cornell University Critical Assembly and were interpreted with the aid of the above theory. Calculations and experiments agree to within 20%. Sjostrand's method is found to give the best result for this reactor. (auth)

40688 MEASUREMENT OF MATERIAL BUCKLING IN VARIOUS SUBCRITICAL ARRANGEMENTS OF NATURAL URANIUM AND LIGHT WATER. Schade, Diethard (Technische Hochschule, Darmstadt, Ger.). Nukleonik, 10: 54-8(July 1967). (In German).

Material buckling was measured in 10 subcritical arrangements. The fuel elements consisted of metallic natural U rods 2 cm diameter; the moderator was light water. Five of the investigated arrangements were crossed grids, which formed a Cartesian coordinate system by superposition of three parallel grids in the three axial directions, the remaining grids were formed by parallel rods in the moderator. The crossed grids yielded a smaller maximum material buckling than the parallel grids. The results indicated that material buckling can be increased by use of a smaller rod radius. Calculation of material buckling in the investigated parallel grids by methods used for interpretation of light enriched U-water reactors gave a satisfactory agreement with experimental values. (tr-auth)

40689 PULSED-SOURCE REACTIVITY MEASUREMENTS IN A REFLECTED REACTOR. Waltar, Alan E. (Battelle-Northwest, Richland, Wash.); Ruby, Lawrence. Nukleonik, 10: 70-7 (July 1967).

An experimental test is presented for a new method of interpreting pulsed-neutron experiments in a reflected reactor. Based on the two-region model an expression for reactivity has been derived which can be evaluated directly in terms of either core or reflector data. The analysis extends the theory to neutron bursts of finite width, and to an arbitrary number of delayed-neutron groups. Allowance is made for the finite integration time of the data acquisition system. Data obtained by pulsing the AGN-201 Reactor at the center of the core were analyzed in two ways. Using the extrapolated-area method the value obtained for reactivity is shown to be quite dependent on detector position for all reactor states below about one dollar subcritical. Analyzing the same data by the new theory, however, results in a unique value of reactivity independent of detector position for all states between critical and shutdown. Similar results were obtained as the source was moved into the reflector. In addition to reactivity, experimental values were obtained for almost all of the lifetimes and coupling co-efficients characteristic of the two-region model. (auth)

40690 THE CONTROL APPARATUS OF THE OSIRIS REACTOR. Sala, A. Instrum. Nucl. (Paris), No. 29, 70-82(May 1967). (In French).

The control instrumentation for neutron, thermal, and hydraulic safety of the 50MW(t) Osiris swimming-pool reactor is described. Various aspects of the control instrumentation discussed are neutron measurements, classical measurements, rod control, automatic operation, safety circuits, detection of cladding rupture, and radioprotection measurements. (J.S.R.)

40691 NEUTRON FLUX ENHANCEMENT IN THE THRU-TUBE OF THE PARR. Ahmed, N. M.; Qazi, M. N.; Najam, M. R.; Khan, Z. U. (Pakistan Inst. of Nuclear Science and Tech., Nilore). Nucl. Instrum. Methods, 54: 159-60(Sept. 1967).

The collimated neutron flux for neutron capture γ ray experiments at the thru-tube of the Pakistan Research Reactor (PARR) has been enhanced by a factor of 27 using a heavy water scatterer. The dependence of the flux and the cadmium ratio on the position of the scatterer with respect to the reactor core are described. (auth)

Production Reactors

40692 DATA PROCESSING APPLICATIONS TO A LARGE DUAL-PURPOSE REACTOR. Leiby, D. W.; Poor, C. F.; Hayner, C. T. (Douglas United Nuclear, Inc., Richland, Wash.). Nucl. Appl., 3: 526-31(Sept. 1967).

Since the initial startup of Hanford's 800 MW(e) N Reactor, a number of digital computer applications have been implemented to assist in the maintenance and operation of the reactor complex. Two information systems were developed: one for storing reactor operating data and fuel-element charge-discharge information, and the other for keeping detailed records on equipment maintenance and associated costs. Both off-line and on-line computer codes have been written for calculating reactor operating limits and reactor parameters not measured directly. This use of an on-line computer for the calculation of process control parameters in conjunction with a large general-purpose computer to maintain reactor information systems has been demonstrated as an effective means of administering reactor process limits and reducing vast amounts of operational and inventory data into acceptable formats. (auth)

Reactor Components, Fuels and Accessories

Refer also to abstracts 39089, 39107, 39173, 39570, 39571, 39573, 39576, 39578-39580, 39583, 39585-39587, 39589, 39590, 39592, 39594-39596, 39599, 39600, 39602, 39607, 39660, 39674, 39678, 39679, 39685, 39687, 39712, 39713, 40345, and 40564.

40693 (AECL-2662) MEASUREMENTS OF THE FISSION PRODUCT GAS PRESSURES DEVELOPED IN UO_2 FUEL ELEMENTS DURING OPERATION. Notley, M. J. F.; DesHaies, R.; MacEwan, J. R. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Nov. 1966. 75p. Dep. CFSTI, CAN $2.00.

An experimental irradiation is described in which the gas pressures developed inside 12 operating UO_2 fuel elements were measured at intervals during irradiation to a maximum burnup of 3290 MWd/tonne U. Results are presented of the effect of heat rating (4 levels) and fuel density (3 levels) on fission product gas release and pressure. A significant proportion of the fission product gas in the fuel was found to be released during reactor power transients, although over the whole irradiation the amount of gas released was approximately proportional to the burnup. An analysis of the observed behavior indicated that most of the release occurred as the element power was lowered. The dependence of gas pressure on element power during the first startup was similar to that predicted using a simple model for fuel behavior; the sintered fuel pellet was considered to crack and deform under the stresses resulting from the fuel thermal expansion. Subsequently, when the expansions of a cracked, deformed pellet govern the gas pressure, the pressure was observed to vary linearly with power output. A decrease in fuel density was found to increase the amount of fission product gas released. However, the gas pressure did not increase in proportion to the amount of gas since there was more void volume in the elements with low density fuel. An element that operated with internal gas pressures in excess of coolant pressure for a long time showed indications of decreased

fuel/sheath heat transfer coefficient and increased sheath strain that is tentatively ascribed to the excess gas pressure. (auth)

40694 (ANL-7349, pp 92-109) GENERAL REACTOR TECHNOLOGY. (Argonne National Lab., Ill.).

A method for noise analysis of fast reactor assemblies using an on-line digital computer was tested. The method allows measurements at high power by use of a cross correlation between two current detectors. Experiments were continued on the determination of oxygen-to-metal ratios of PuO_2 and PuO_2-UO_2 specimens at high temperatures. An electron probe microanalyzer was used to determine the chemical behavior of fission products within an irradiated urania fuel pin. Irradiation testing of Th-U-Pu alloys, UC-PuC, PuC, and US fuel materials was continued, and properties of Th, U, and Pu compounds having the NaCl-type structure were investigated. The heat capacities of the PuS and PuP were measured between room temperature and 650°C, and tests were conducted in the development of a neutron-image intensification system. Countercurrent turbulent liquid-metal flow was studied for double-pipe heat exchangers, and the development of an acoustic boiling detector for Na coolant was continued. Laboratory and engineering work was conducted on the recovery of U and Pu from low-enrichment oxide fuels by the fluoride volatility process. (H.D.R.)

40695 (EURAEC-1886) THE USE OF PLUTONIUM AS FUEL IN NUCLEAR REACTORS. Quarterly Report No. 13, January 1-March 31, 1967. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium). Societe Belge pour l'Industrie Nucleaire, Brussels). Apr. 1967. 65p. (EUR-3382; BN-6704-14). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

The development of oxide-based ceramic fuels is continuing. UO_2 fusion tests have continued to optimalize the crushing parameters. By increasing the frequency to 4.6 MHz, a 1 mm external skin was obtained. In the use of the Pu encased pneumatic vibrator, the work is being directed to a phase which must solely ensure tightness between the box and the can of the rod to be filled. Pneumatic vibrator gripper systems are being studied. To ensure regular powder flow, preference is given to gravimetric proportioning by increment batch weighing. The solution of gravimetric proportioning by one single balance has been retained. A new coulometry assembly has been put into service in a glove box for the analysis of the Pu content. This assembly is more sensitive and is more easily adjusted. The humidity analysis apparatus has been put in a Pu box. It attains a detection limit of 2 μg of water. The best decontamination results in transferable Pu are at present obtained by electro-polishing. The detailed program of the first four burn-out tests on rods with local overpower has been drawn up. The metallographs of sections of the homogeneous rod irradiated at about 1400 W/cm during the fourth irradiation run in the hydraulic crusher reveal the formation of grains in columns in a radius of about 5 mm. Signs of the beginning of central fusion also appear. On the basis of the present power determinations the geometrical factor intervening in the conductivity integrals of the homogeneous type rods is between 0.6 and 0.75. The heterogeneous rod irradiated in the third boiling water capsule has attained a burn-up rate in the region of 12,000 MWd/t and a peak power of 350 W/cm. The quantity of fission gas collected in a cold state from the plutoniferous rods produced in the MOL laboratories and irradiated in the BR3/PWR is much greater than that extracted from the uraniferous pellet rods. The procedure for radio-chemically proportioning ^{148}Nd in the UO_2-PuO_2 fuel has been established. A Panther code sub-routine has been elaborated by ignoring the thermalization in the fuel and treating the heterogeneity of the cell by either the Spectrox method or by the Amouyal and Benoist method. A second has been effected by treating the canning and the fuel of a cell at several points by the theory of first impacts to take into account any heterogeneous PuO_2 distribution in the UO_2-PuO_2 rods. Calibration of the Panther code for calculating the UO_2 and UO_2-PuO_2 lattices has led to different modifications to the MUFT-BN section. Processing of the data arising from the subcritical experiments on VENUS-VULCAIN fuel has been undertaken. On the experimental side, the grids of the critical VENUS installation have been put into position and the vessel emptying time has been measured with a dummy core present. A fuel management study of the first cycles of the SENA Reactor and the results obtained with the help of the GAMBLE code have been a analyzed. (J.C.W.)

40696 (GEAP-3896) CALIBRATION OF TWO INSTRUMENTED REACTOR FUEL ASSEMBLIES FOR THE HIGH POWER DENSITY DEVELOPMENT PROJECT. Janssen, E.; Kervinen, J. A. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Feb. 15, 1962. Contract AT(04-3)-361. 64p. Dep. CFSTI.

The development of two instrumented fuel assemblies is presented. Out-of-pile calibration of the static pressure and flow sensors, under both single-phase and two-phase flow, is detailed. Calibration results are compared to manufacturer's calibration. (M.L.S.)

40697 (ORNL-P-3205) A SIMPLIFIED APPROACH TO CALCULATING CONVECTIVE PLATEOUT OF FISSION PRODUCTS. Kress, T. S.; Neill, F. H. (Oak Ridge National Lab., Tenn.). [1966]. Contract W-7405-eng-26. 4p. (CONF-671102-9). Dep. CFSTI.

For Presentation at 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

Two mathematical simplifications are presented to alleviate deficiencies of the analyses of the transport and deposition of fission products in a reactor coolant circuit. (J.C.W.)

40698 (EURFNR-286) PHASE RELATIONSHIPS, FABRICATION AND PROPERTIES OF SUB-STOICHIOMETRIC OXIDE NUCLEAR FUEL (UO/sub 2-x/ AND (UPu)O/sub 2-x). Thuemmler F.; Theisen, R.; Patrassi, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Translation of report KFK-543. 34p. Dep.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

The concept of a sub-stoichiometric oxide nuclear fuel is discussed in the light of the publications and our own results. At low temperatures there is no danger of a metallic U or Pu precipitation with the Pu contents. The problems posed by the fabrication of pellets and vibration powder from $(UPu)O_{2-x}$ are technically solvable. Compatibility with clad materials is improved in the case of one-phase sub-stoichiometric products. Heat conductivity is increased moderately, at least up to 1200 to 1500°C. The improved heat conductivity is also apparent in the practical irradiation test. (auth)

40699 CONTRIBUTION TO THERMOKINETICS OF REACTOR FUEL ELEMENTS IN THE FORM OF CONCENTRIC TUBE CLUSTER. Novotny, Prokop (Inst. of Nuclear Research, Czechsolovakian Academy of Sciences, Rez). Jad. Energ., 13: 94-8(Mar. 1967). (In Czech).

The analysis of thermokinetic conditions in a fuel element in the form of a concentric tube cluster with or without a plug in the center is discussed. It comprises the solution of a temperature field within the element for a general case of unequal coolant outlet temperatures in individual streams and investigates the conditions in which these temperatures may be equal. These considerations are carried out for simplicity reasons for the case if temperature variations in fuel thermal conductivity and radial variations of volume density of thermal sources in individual fuel elements may be neglected. Both quantities are assumed to be averaged in each individual fuel element in this case. The possibilities of application of the results of this analysis for thermokinetic calculations of reactor fuel elements of the considered type are indicated. (auth)

40700 CALCULATION OF NEUTRON SPECTRA IN ZIRCONIUM HYDRIDE IN THE NELKIN APPROXIMATION. Roehrborn, B.; Pucher, M. (Technische Hochschule, Stuttgart. Bundesministeriums fuer Wissenschaftliche Forschung, Bad Godesberg, Ger.). Nukleonik, 10: 89-91(July 1967). (In German).

The Nelkin scattering model is suitable for calculation of neutron flux spectra in zirconium hydride-moderated reactors. The gas masses M_{eff} = 360 m and M_{eff} = 25 m were used since, whether acoustic or optical energy transitions are treated, the calculated response to neutron flux spectra at 26 energy groups can be relinquished for an exact average for formation of group cross sections. The calculations were tested by comparison with measured neutron spectra that exist at room temperature, since at this temperature the crystal effect is especially recognizable. (tr-auth)

40701 SOME REMARKS ON THE PRACTICAL USE OF THE p-METHOD IN REACTOR NOISE ANALYSIS. Dragt, Jan B.; Turkcan, Erdinc (Reactor Centrum Nederland, Petten). Nukleonik, 10: 67-9(July 1967).

The p-method in reactor noise analysis is the Russian technique of deriving reactor parameters from the experimentally determined probability p_k for detecting k neutrons in a certain time interval. Some approximations for the calculation of the p_k are considered. Besides a direct analysis of p_0, also the use of p_1 or p_{even} is feasible. Some difficulties met in the analysis of the experimental data are discussed. The most practical way of analysis seems to be a non-linear least squares analysis where some precautions have to be taken. (auth)

40702 MODEL STUDY OF LATERAL SUPPORTS FOR NUCLEAR REACTOR FUEL ELEMENTS. Spengos, A. C. (Scott Paper Co., Philadelphia). New York, American Society of Mechanical Engineers, 1966, Preprint No. 66-WA/NE-20, 11p., $1.50. (CONF-661102-31). DTIE.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

Head losses have been determined for flow through a bundle of fuel-element rods supported by four different forms of lateral supports at variable spacings. The drag coefficient for each type of support has been computed from the measurements of the pressure drop, and the influence of the boundary proximity has been determined. (auth)

40703 BEHAVIOUR OF STAINLESS STEEL IN SODIUM TEMPERATURE RANGE OF 600 TO 900°C. Agapova, N. P.; Ioltukhovskii, A. G.; Romaneev, V. V. Vienna, International Atomic Energy Agency, 1966, Preprint No. SM-85/51, 18p. (In Russian). (CONF-661110-10). DTIE.

From IAEA Symposium on Alkali Metal Coolants, Corrosion Studies, and System Operating Experience, Vienna.

The interaction between various types of stainless steel used in reactor heat exchangers, and liquid Na, containing 10^{-4} to 10^{-2} weight % of O_2 and flowing under forced circulation, was investigated on a test stand provided with a Zr trap. The 49 × 6 × 0.4 mm specimens used for stress corrosion studies were tested under Ar cover gas and biaxial loading. The results indicated that the experimental conditions used, especially the temperature and the flow rate of the liquid Na affects strongly the resistance. Tests with pure metals showed that increase of the O_2 content reduces the resistance of Fe and Cr and increases that of Ni. An increase of the Ni content of industrial stainless steels improved their corrosion resistance, approaching that of Ni, while reduction of the Ni concentration shifted the corrosion resistance toward that of Fe. The simultaneous increase of temperature beyond 800°C and of the flow rate above 3 m/sec, resulted in a catastrophic destruction of high-Ni alloys. The effect of other alloying additions, such as C, Ni, Si, Mn, Mo, Nb, Ti, etc., was also examined. It was concluded that a stainless steel surface in contact with liquid Na should contain as little Ni as compatible with the mechanical strength requirements. The presence of W and Mo is desirable. (TTT)

40704 GRAPHITE CAN FOR A HIGH TEMPERATURE FUEL ELEMENT AND ITS METHOD OF MANUFACTURE. (to CEA). French Patent 1,349,373. Dec. 9, 1963. Filed Dec. 5, 1962.

An impermeable can for a high temperature fuel element is made of a graphite tube, closed at its extremities by graphite plugs, the interior surfaces of said tube and plugs coated with pyrolytic carbon and the plugs joined to the tube by pyrolytic carbon. Schematic apparatus for coating tube and plugs by thermal decomposition of hydrocarbons is described. (NPO)

40705 CONTROL DEVICE FOR NUCLEAR REACTORS. Smith, R. A. (to U. S. Atomic Energy Commission). U. S. Patent 3,344,034. Sept. 26, 1967.

Improvements in a nuclear reactor control rod comprised of a rod like member and a feed means to vary the extent of the rod's penetration into the core are presented. The rod is coupled with a feed member of the feed means through an energized electromagnet which on de-energization releases the rod for immediate insertion into the core. The feed member is a lead screw engaging a nut device of the recirculating ball type. A vernier motor, connected to the nut device, creates stepwise angular motion to establish accurate control of the position of the rod. (AEC)

40706 REACTOR MATERIALS. Volume 10, Number 2. Simons, E. M.; Porembka, S. W. Jr.; Keller, D. L. (eds.). A Quarterly Technical Progress Review published for the Division of Technical Information, USAEC. Columbus, Ohio, Battelle Memorial Inst., Summer 1967. 64p. GPO $0.70 Domestic, $0.90 Foreign.

Highlights of significant new developments are presented on the properties, behavior and fabrication processes of materials applicable to nuclear reactor components and associated equipment. Individual sections are: Fuel and Fertile Materials, Moderator Materials, Nuclear Poisons, Cladding and Structural Materials, and Special Fabrication Techniques. Separate abstracts were prepared for each of the five sections. (H.D.R.)

For abstracts of individual sections see: 40707–40711.

40707 FUEL AND FERTILE MATERIALS. Reactor Mater., 10: 69-82(Summer 1967).

Unalloyed U, α-phase U alloys, and γ-phase U alloys are discussed in a report on reactor fuels and fertile materials. Pu, Pu compounds, and Th are discussed for reactor systems. Metal-ceramic and coated-particle fuel evaluations are given. Properties and behavior of urania, thoria, uranium carbides, uranium nitrides, uranium phosphides, and uranium sulfides are summarized. Reactions between reactor fuel materials and water and studies involving irradiation effects in fuel materials are discussed in the summary containing 73 references. (J.C.W.)

40708 MODERATOR MATERIALS. Reactor Mater., 10: 83-90(Summer 1967).

Graphite as a reactor moderating material is discussed. Physical metallurgy, corrosion, radiation damage, fabrication, and analysis of Be and beryllium alloys are properties summarized for moderator materials. Beryllium oxide was tested for use in a moderator and the results compared. Zirconium hydride and lanthanum hydride are investigated. The report includes 22 references. (J.C.W.)

40709 NUCLEAR POISONS. Reactor Mater., 10: 91-2(Summer 1967).

A review of materials used for nuclear burnable poisons is summarized. Gadolinium, boron and boron compounds, and rare earths are considered for discussion. Five references are cited. (J.C.W.)

40710 CLADDING AND STRUCTURAL MATERIALS. Reactor Mater., 10: 93-120(Summer 1967).

Corrosion studies of Zr alloys, Al alloys, stainless steel, nickel-base alloys, and refractory metals are reviewed. The behavior and results of corrosion testing are reviewed for liquid metals and fused salts. A calculational technqiue for describing the extent of a metal–water reaction and core heating during a loss-of-coolant accident is reported. Radiation effects on nonfuel materials are summarized. Metallurgical aspects of cladding materials and mechanical properties of cladding and structural materials are discussed and graphs and tables included. Evaluations of refractory materials and their properties and preparation are reported. 131 references are listed. (J.C.W.)

40711 SPECIAL FABRICATION TECHNIQUES. Reactor Mater., 10: 121-33(Summer 1967).

Studies on fabrication technique for reactor materials include melting and casting, hot and cold working of cast materials, powder metallurgy, pressure bonding, nonelectrolytic chemical plating and electroplating, explosive metalworking, and joining techniques. Ultrasonic techniques and nondestructive techniques other than ultrasonic are discussed. There are 61 references listed. (J.C.W.)

40712 ORGANIC FLUIDS, USABLE IN A NUCLEAR REACTOR AS COOLANTS, MODERATORS OR REFLECTORS. (to Commissariat a l'Energie Atomique. Institut Francais du Petrole des Carburants et Lubrifiants). French Patent 1,402,824. May 10, 1965. Filed June 28, 1963.

The coolant, moderator or reflector of a nuclear reactor consists of a mixture of ca. 28% unsubstituted terphenyls with alkylaromatics of petroleum origin, e.g., alkylphenanthrenes derived from reforming residues. Said mixtures are liquid at room temperature and possess an excellent stability. (NPO)

40713 NEW STEELS FOR THE CONSTRUCTION OF NUCLEAR REACTORS. (to Kloeckner Werke A.G.). French Patent 1,271,903. Aug. 7, 1961. Priority date Oct. 22, 1959, Germany.

Austenitic steels, containing 18 to 24% Cr and 8 to 12% Ni, are alloyed with 0.0001 to 0.05% rare earths, preferably with 0.08% Ce. Said steels are highly resistant to aqueous corrosion in nuclear reactors. (NPO)

40714 FUEL ELEMENT WITH IMPROVED DIFFUSION BARRIER FOR NUCLEAR REACTORS. (to EURATOM). French Patent 1,379,838. Oct. 19, 1964. Priority date Nov. 16, 1962, Belgium.

A diffusion barrier is applied in the form of one or more very thin metal strips which are wrapped around the fuel core. Various embodiments are described. (NPO)

40715 FUEL ELEMENT FOR A NUCLEAR REACTOR. (to Fulcrum Aktiebolag). French Patent 1,325,057. Mar. 18, 1963. Filed Mar. 15, 1962.

The fissile core of a fuel rod consists of an axial ceramic part and a peripheral metallic part, both parts being joined by a gaseous, liquid or solid interlayer to promote heat transfer. (NPO)

40716 CLAD ELEMENT FOR REACTORS AND ITS METHOD OF MANUFACTURE. (to Deutsche Gold- und Silber-Scheideanstalt). French Patent 1,174,429. Nov. 3, 1958. Priority date May 2, 1956, Germany.

A fuel element, consisting of a metal fuel core in an Al jacket is provided with a composite diffusion barrier, consisting of a

first layer of a fuel–Zn alloy and a second layer of one of the metals Pb, Bi, Sn, Be, Ca, Mg, Al, Si, V, or Fe. (NPO)

40717 NUCLEAR FUEL ELEMENT. (to CEA). French Patent 1,407,720. June 28, 1965. Filed June 22, 1964.

The fuel element is provided with an interlayer between the U core and the Mg alloy jacket, to prevent Pu diffusion. A preferred interlayer consists of an Al alloy with 0.5 to 12% Si and 0.5 to 5% Mg and has a thickness of 5 to 50 microns. Other suitable materials are Mo and/or Be. (NPO)

40718 FUEL ELEMENTS FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,421,874. Nov. 8, 1965. Priority date Jan. 30, 1964, Great Britain.

A fuel element is provided with a thermocouple cable running through a cutting device at the exterior of the elements, which device cuts the cable in two as soon as an abrupt traction is exerted on it. (NPO)

GENERAL

40719 (AD–650265) MATERIALS SCIENCES RESEARCH. Annual Technical Report, 1965–1966. (Illinois Univ., Urbana. Materials Research Lab.). Nov. 1, 1966. Contract SD-131. 157p. CFSTI.

Brief summaries are given of the status and results of research programs in the areas of cryogenics, crystallography, spectroscopy, metal physics, superconductivity, semiconductors, solid-state physics and electronics, phase studies, high-pressure research, radiation damage, and related topics. A complete listing of published papers and theses is included. (TAB)

40720 (CONF-661052) CONFERENCE ON "CONVERSATION WITH A 50" HELD AT ARGONNE NATIONAL LABORAOTRY, ILLINOIS, OCTOBER 31–NOVEMBER 1, 1966. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 102p. Dep. CFSTI.

Nine papers are presented on time-sharing conversational-mode programming systems with remote consoles for the IBM System/360 Model 50. (B.G.D.)

40721 (COO-299-2) COMPUTER EVALUATION OF "ENTROPY" TITRATION DATA: DETERMINATION OF β_1^0, ΔH_1^0 AND ΔS_1^0 VALUES FOR THE SILVER(I) PYRIDINE SYSTEM. Christensen, James J.; Eatough, Delbert; Izatt, Reed M.; Snow, Richard L. (Brigham Young Univ., Provo, Utah). Dec. 19, 1966. Contract AT(04-3)-299. 15p. (CONF-661128-1). Dep. CFSTI.

From American Chemical Society, Southwestern Regional Meeting, Albuquerque, N. Mex.

Log K_1, ΔH_1^0 and ΔS_1^0 values were determined for the stepwise formation of $AgPy_2^+$ (Py = pyridine) from Ag^+ and Py using a thermometric titration procedure. The results agree well with previously determined values and demonstrate that titration calorimetry can be used to determine log K, ΔH^0, and ΔS^0 values for metal–ligand systems. Four iterative methods of data analysis are compared and discussed. (auth)

40722 (COO–614-54) ICR QUARTERLY REPORT NUMBER 13. Yngve, Victor H. (Chicago Univ., Ill. Inst. for Computer Research). May 1, 1967. Contract AT(11-1)-614. 83p. Dep. CFSTI.

A progress report from the Institute for Computer Research is given. The main topics are Maniac III engineering activity, the Man-Machine project, the Uncill list-processing language, the approximation solvability of nonlinear equations, and a bi-directional simplex algorithm. (B.G.D.)

40723 (K–1723) EXISTENCE-UNIQUENESS THEOREMS FOR NON-LINEAR DIRICHLET PROBLEMS. Lick, Dale W. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). Aug. 23, 1967. Contract W-7405-eng-26. 9p. Dep. CFSTI.

Existence-uniqueness theorems are proved for the Dirichlet problems for the nonlinear equations $\nabla^2 u - [c_1 u/(1 + c_2 u)] = 0$, $u \geq 0$, $\nabla^2 u + [c_1/(1 + c_2 u)] = 0$, $u \geq 0$, and $\nabla^2 u - f(u) = 0$, $u \geq 0$ with boundary condition $u = \phi \geq 0$. (auth)

40724 (KAPL-M–6708) MIMIC: A DIGITAL SIMULATOR PROGRAM. Cullen, R. J.; Lechliter, G. L. (Knolls Atomic Power Lab., Schenectady, N. Y.). May 15, 1967. Contract W-31-109-eng-52. 59p. Dep. CFSTI.

A digital computer program, MIMIC, is described for solving systems of ordinary differential equations on a CDC-6600 computer with the SCOPE 2.0 operating system. MIMIC was written to provide those engineers and scientists who do not have backgrounds in computer techniques with a simple but effective means of communicating with a digital computer, yet the language is flexible enough to appeal to the professional programmer, either analog or digital. MIMIC is an advanced version of an earlier computer program called MIDAS. The execution time is very problem dependent. A typical second order model would run in <20 seconds. (auth)

40725 (KAPL-M–6709) SNEQ: A COMBINATION OF PROGRAMS TO PLOT CURVES AND/OR SOLVE NONLINEAR ALGEBRAIC EQUATIONS. Lechliter, G. L. (Knolls Atomic Power Lab., Schenectady, N. Y.). May 30, 1967. Contract W-31-109-eng-52. 35p. Dep. CFSTI.

Two computer programs that can be used in conjunction with the SLIP compiler for solving and/or displaying input equations are described. The two programs presented are: SNAP—a program to solve nonlinear, algebraic equations, and EQPLT—a program that reads equations as input and plots the results. This is extremely useful for parameter studies. Also, since these two programs both use the SLIP compiler, they have been combined and are both callable from within a single run. These programs are written in the FORTRAN-IV language. The approximate running time for a typical problem is 2 seconds. (auth)

40726 (LA–3717) EXPERIMENTS ON ERROR GROWTH ASSOCIATED WITH SOME LINEAR LEAST-SQUARES PROCEDURES. Jordan, T. L. (Los Alamos Scientific Lab., N. Mex.). June 1, 1967. Contract W-7405-eng-36. 9p. Dep. CFSTI.

Some numerical experiments were performed to compare the performance of procedures for solving the linear least-squares problem based on Gram-Schmidt, Modified Gram-Schmidt, and Householder transforhations, as well as the classical method of forming and solving the normal equations. In addition, similar comparisons were made of the first three procedures and a procedure based on Gaussian elimination for solving an $n \times n$ system of equations. The results of these experiments suggest that: the Modified Gram-Schmidt procedure is best for the least-squares problem and that the procedure based on Householder transformations performed competitively; all the methods for solving least-squares problems suffer the effects of the condition number of ATA, although in a different manner for the first three procedures than for the fourth; and the procedure based on Gaussian elimination is the most economical and essentially the most accurate for solving $n \times n$ systems of linear equations. Some effects of pivoting in each of the procedures are included. (auth)

40727 (LA-DC–8921) COMPUTATIONAL METHODS IN THE NET-1 NETWORK ANALYSIS PROGRAM. Malmberg, Allan F. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 62p. Dep. CFSTI.

A computer program (NET-1) is described which is used for network analysis of linear and nonlinear electronic circuits. The computational methods are based upon the solution of simultaneous sets of nonlinear algebraic and differential equations. The transient and the dc steady-state problems are fully discussed. (B.G.D.)

40728 (BNL–11676) SOLUTION OF PROGRAMMING PROBLEMS BY GENERATING FUNCTIONS. Thurber, James K. (Brookhaven National Lab., Upton, N. Y.). [1967]. 73p. (CONF-670817–1). Dep. CFSTI.

From International Symposium on Mathematics Programming, Princeton, N. J.

A method has been developed for solving integer programming problems by using generating functions. By means of the generating functions the feasible solutions for a system with linear constraints can be represented in terms of new sets of integer variables which satisfy only the trivial constraints that they be nonnegative. The minimization problem then becomes a triviality in in principle although in practice it may lead to a tedious computation. Examples are included where both situations occur (i.e., where the method gives quick solutions and where it is impractical). The procedure is based on an extension and simplification of some ideas of P. A. MacMahon on the theory of partitions. In addition the method leads to some results in multiplicative number theory, greatly generalizing some well known identities involving the Riemann zeta function. The algorithm also has a continuous analog which amounts to solving simultaneous linear inequalities by means of Laplace transforms. The representation of the feasible solutions by means of Laplace transforms also eliminates all the non-trivial constraints and permits the minimization problem to be dealt with via classical methods of the calculus for non-linear objective functions and reduces the case of linear objective functions to a trivial although possibly tedious computation. (auth)

40729 (BNWL–493) PLUTONIUM ABSTRACTS. Volume 7, Number 6. Russell, Barbara G. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 30, 1967. Contract AT(45-1)-1830. 41p. Dep. CFSTI.

Summaries are presented of 105 publications from literature published throughout the world that report new developments in plutonium technology. The summaries are grouped under the following subject fields; biology and medicine, chemistry, health and safety, metallurgy and ceramics, physics, and reactor technology. (C.H.)

40730 (MIT–66TR51) SHAKE TABLE TESTS OF A SPIRAL-GROOVED JOURNAL BEARING. Malanoski, S. B. (Mechanical Technology Inc., Latham, N. Y.). Feb. 1967. Contract Nonr-3730(00). 28p. (AD–656398). Dep. CFSTI.

A 1.5 in. dia, L/D = 1, spiral-grooved, gas journal bearing with a rotor weight of 2¼ lb. per bearing, mounted in a housing (total weight of approximately 100 lb.) was subjected to a one (1) g vibrating load over a frequency spectrum of 20 to 2000 cps. Tests

were made at rotor speeds of 12,000, 20,000 and 30,000 rpm. The only static bearing load imposed was the rotor weight. The in-line and perpendicular frequency responses of the rotor (both magnitude and phase angle) were measured and recorded. No sign of bearing touchdown was detected. Correlation between this experimental data and available theoretical data was good. (auth)

40731 (MLM-1358) DECOMPOSITION OF TOLYLENE DIISOCYANATE DIMER IN THE PRESENCE OF n-HEXANOL. Dichiaro, J. V. (Mound Lab., Miamisburg, Ohio). Aug. 4, 1967. Contract AT-33-1-GEN-53. 8p. Dep. CFSTI.

The reaction of 2, 4-tolylene diisocyanate dimer (TDID) with n-hexanol at 130°C was studied to establish the reaction course of TDID as a cross-linking agent for hydroxylated rubbers. A study of the reaction products by infrared spectrophotometry and thin-layer chromatography showed that TDID did not cleave during a 1 hr reaction. Thus, the TDID molecule reacts in a difunctional manner under these conditions. (auth)

40732 (NLCO-1001) SUMMARY TECHNICAL REPORT [ON FEED MATERIALS PRODUCTION], APRIL 1, 1967-JUNE 30, 1967. Burgett, R. (ed.) (National Lead Co. of Ohio, Cincinnati). Aug. 1967. Contract AT(30-1)-1156. 93p. Dep. CFSTI.

Progress is reported in seven sections and a separate abstract was prepared for each section. (M.C.G.)

For abstracts of individual sections see: 38874, 48999, 39000, 39561, 39615, 39684, and 39696.

40733 (NYO-2032-21) STUDIES OF HUMAN BONE MARROW TRANSPLANTATION IN ACUTE LEUKEMIA AND APLASTIC ANEMIA. Final Report, June 1, 1957-May 31, 1966. Dameshek, William (New England Medical Center Hospitals, Boston, Mass.). July 14, 1967. Contract AT(30-1)-2032. 5p. Dep. CFSTI.

Results are summarized from a series of animal studies that resulted in clinical trials of bone marrow transplants in the treatment of acute leukemia and aplastic anemia. Emphasis was placed on the use of antimetabolite drugs to minimize the rejection of transplanted tissues by the host. Good results were obtained using 6-mercaptopurine (6-MP), imuran (imidoyle 6-MP), cytoxan, and other analogs of 6-MP. Methods were developed for removing large amounts of bone marrow from normal individuals and injecting it into patients by the intravenous route. Other techniques studied included the injection of spleen tissues, the effects of tymectomy on immune reactions, and the effects of anti-lymphocyte serum on immune reactions to transplanted tissues. Results of clinical trials are reported. (C.H.)

40734 (NYO-3748-4) DATA MANAGEMENT SYSTEM FOR ON-LINE IMAGE PROCESSING ON A RELATIVELY SMALL COMPUTER. Curtis, Z. B.; Neurath, P. W.; Vetter, H. G. (Tufts-New England Medical Center, Boston, Mass.). Aug. 8, 1967. Contract AT(30-1)-3748. 3p. (CONF-670814-1). Dep. CFSTI.

From 12th Society of Photo-optical Instrumentation Engineers Symposium, Los Angeles, Calif.

The Data Management System (DMS) was designed for analysis of human chromosome spreads, but it is applicable to other image-processing tasks, especially where high spatial resolution is desired. The system operates with the IBM System 360 Model 30 computer using 32 K of core storage and a large, but relatively slow speed and inexpensive disk storage. The high-density scanning array contains 600,000 points. (W.E.B.)

40735 (ORNL-4156) PROBABILITY DISTRIBUTION ARISING IN A RIFF-SHUFFLE. Uppuluri, V. R. Rao.; Blot, W. J. (Oak Ridge National Lab., Tenn.). Sept. 1967. Contract W-7405-eng-26. 33p. Dep. CFSTI.

A discrete random variable X = 0, 1, 3, . . . , m-1, with probability density function $\binom{m+x-1}{x}(p^m q^x + q^m p^x)$, p > 0, p + q = 1, has arisen during the study of riff-shuffles as a Markov Process. An expression for the moment generating function of this variable is obtained, from which the mean and variance are derived. By equating two different expressions for the mean of the variable, a closed form for the incomplete beta function with equal arguments is obtained as $I_p(m,m) = p + (p-q)\sum_{k=1}^{m-1}\binom{2k-1}{k}(pq)^k$. It is shown how this expression helps for the rapid computation of the incomplete beta function with integral arguments. This expression is also used in deriving the asymptotic (m-large) expressions for the mean and variance. The standardized variate is shown to converge to the Gaussian distribution as $m \to \infty$. A result corresponding to the DeMoivre-Laplace type theorem is proved for m sufficiently large. Finally, applications are indicated to the genetic code problem, to Banach's match box problem and to the World Series of baseball. (auth)

40736 (ORNL-P-3296) ENGINEERING SUPPORT FOR THE MOLECULAR ANATOMY PROGRAM. Anderson, Norman G. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 16p. (CONF-670925-1). Dep. CFSTI.

From National Institute of Health Conference on Future Goals of Engineering in Biology and Medicine, Washington, D. C.

Engineering aspects of the development of techniques for cell production and cell fractionation are discussed. The major problem areas briefly described and discussed are as follows: cell culturing on a large scale; controlled cell breakage; development of automated analytical systems for the analysis of various classes of low molecular weight substances; development of automated systems for determining sequences in proteins and nucleic acids; development of automated systems for enzyme assay; development of data reduction techniques; development of higher resolution techniques for fractionation of mixtures of macromolecules; development of techniques for disassembly of each subcellular particle species; high resolution separation of subcellular fractions by centrifugal techniques; and integration of results with the aim of developing clinically useful diagnostic techniques. (B.H.S.)

40737 (ORO-2945-9) FASTENING OF WOOD-PLASTIC COMBINATIONS. Topical Report. Loos, Wesley E.; Kent, James A. (West Virginia Univ., Morgantown. Engineering Experiment Station). Sept. 1, 1967. Contract AT(40-1)-2945. 38p. Dep. CFSTI.

Fastening wood-plastic combinations (WPC) by both adhesives and mechanical fasteners was studied. Wood-plastic combinations can be satisfactorily glued before or after treatment. The gluability of several radiation produced wood-plastic combinations was tested with four commercially available adhesives. Resorcinal based adhesives gave the best results of the glues tested. Polyvinyl acetate (PVC) urea-formaldehyde (U-F) casein adhesives formed satisfactory glue bonds with WPC as long as the polymer loading of the WPC was not too high. By using WPC with a lower moisture content the glue bonds formed by PVC and U-F adhesives were much better than those produced by WPC with a high M. C. These results indicate that if U-F or PVA adhesives were formulated with a moisture diffusion rate to match that of the WPC, the glue bonds obtained would probably be improved. Mechanical fasteners such as conventional wood screws and threaded fasteners perform quite satisfactorily in fastening WPC. It is strongly advised not to try to nail WPC. Three threaded inserts plus a standard tapped hole and bolt were evaluated. All of these thread-type inserts gave high performance in fastening WPC. (auth)

40738 (ORO-3108-29) AN INVESTIGATION OF SOME PROPERTIES OF THREE DIMENSIONAL VOIDS IN FACE CENTERED CUBIC METALS. Sigler, Julius Alfred (Virginia Univ., Charlottesville). Aug. 1, 1967. Contract AT(40-1)-3108. 94p. Dep. CFSTI.

Thesis.

From data obtained for relative density changes as a function of strain in Au, it was concluded that there is no increase in density for small strains, and thus, that voids are not present in appreciable extent in furnace-cooled gold. The calculated value for the volume deficiency per dislocation segment is too high. A model was formulated and employed to explain the collapse of voids in quenched metals, and to a first approximation, the calculated results for the time of collapse as a function of quenching temperature are in good agreement with the observed behavior of Ni and Au. (M.C.G.)

40739 (PAEC(A)IN-631(Suppl.2)) NUCLEAR ENERGY IN THE PHILIPPINES. An Annotated Bibliography. (Philippine Atomic Energy Commission, Manila). Aug. 1966. 28p. Dep.

A bibliography including 75 references that cover research reports of the Philippine Atomic Energy Commission from April 1964 to December 1965 is presented. The bibliographic data included are author, title of publication, volume, date, and pages. A brief abstract of the article is also included. (B.G.D.)

40740 (RISO-M-587) A-4 SIZE EDITING. Poulsen, N. J. (Danish Atomic Energy Commission, Risoe. Research Establishment). July 1967. 5p. (R-10-67). Dep.

The program is used for producing a printed output of a symbolic tape on Teletype in such a way that the output appears in A-4 size. (auth)

40741 (RISO-M-595) ROUTINES FOR HYBRID COMPUTATIONS WITH EA1 680 AND PDP 8. la Cour Christensen, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). July 1967. 19p. (R-15-67). Dep.

A set of standard routines for hybrid computations are described. The routines cover analog input and output, relay-controlled potentiometer setting, interrupt identification for the hybrid interface

equipment, and conversion from fixed to floating points numbers and and vice versa. (auth) (DENM)

40742 (RISO-M-596) TEST PROGRAM FOR ANALOG INPUT EQUIPMENT 138E/139E FOR PDP8. la Cour Christensen, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). July 1967. 10p. (R-16-67). Dep.

The program is used to test the AD converter and multiplexer. The input channels are connected to stable and calibrated voltages, which are converted and printed out on the Teletype. Three operation modes are possible: A channel sequentially, one channel selected and all channels sequentially. (auth) (DENM)

40743 (RLO-1547-5) MANGANESE ABSORPTION BY BARLEY ROOTS. Maas, Eugene Vernon (Oregon State Univ., Corvallis). June 1967. Contract AT(45-1)-1547. 153p. Dep. CFSTI. Thesis.

An investigation of Mn uptake by five-day-old excised barley roots revealed that a metabolically-mediated process was involved. In short-term experiments, the rate of Mn absorption was comparable to that of the macronutrient cations. Like other metabolically absorbed cations, the Mn absorption rate was a direct function of the ambient concentration and the pH. An evaluation of mutual effects between Mn and other cations revealed several specific regulatory effects. Of the alkali cations studied, Li alone had a pronounced stimulatory effect while Na, K and Rb markedly reduced the absorption of Mn. The alkaline earth cations also exerted widely differing effects. Calcium appeared to promote the absorption of Mn, whereas Mg had a highly inhibitive effect. The combination of both Ca and Mg was even more inhibitory. Strontium apparently was without effect and Ba had a moderately depressive effect. Other polyvalent cations which were effective inhibitors of Mn absorption were Fe^{++}, Zn, Cu, Al and La. In contrast, Fe^{3+} was virtually without effect. Manganese effectively blocked the absorption of Li and Mg, but greatly enhanced that of Na, K and Rb. These diverse regulatory effects and many others reported in the literature are explained by the following hypothesis: the cationic environment at the extracellular surface of the membrane is believed to control the specificity of the ion carrier. By attaching to critical activation sites, cations induce conformational changes in the carrier which modify its selective transport properties. The accessibility or affinity of transport sites for a given ion would depend on the particular configuration of the carrier. This mechanism, together with the mutual competition between some ions for the same transport site and the cationic maintenance of the cellular membranes, would explain most, if not all, of the regulatory effects exerted by cations on the ion absorption process. (auth)

40744 (RLO-1727-10) AQUATIC MYXOBACTERIA; CHONDROCOCCUS COLUMNARIS. Progress Report, 1967. Ordal, E. J. (Washington Univ., Seattle. Dept. of Microbiology). Aug. 15, 1967. Contract AT(45-1)-1727. 21p. Dep. CFSTI.

Progress is reported in epidemiological studies on fish, with emphasis on columnaris disease. Chondrococcus columnaris was isolated from cultures of Myxobacterales obtained from salmon in the Fraser River Basin, Columbia River Basin, and other areas in the Pacific Northwest suffering from columnaris disease, from salmon in Ireland suffering from Irish salmon disease, from fish from England where huge mortalities occurred in a variety of fish in the summer of 1966, and from diseased warm water pond fishes obtained from the southern U.S. Bacteria from the various sources were investigated for genetic relatedness by DNA competition, and the percentage of quanine and cytosine in DNA were determined by thermal denaturation. Analyses of virulence were carried out using the contact method of infection. The cultures of columnaris-like organisms from Irish salmon disease exhibited growth characteristics and pathological effects different from those of Pacific Northwest strains of C. columnaris. The effects of water temperature on the incidence of columnaris disease in fish and the pathogenicity of other aquatic myxobacteria in fish were also studied. (C.H.)

40745 (RLO-1750-22(Vol.3)) ECOLOGICAL STUDIES OF RADIOACTIVITY IN THE COLUMBIA RIVER ESTUARY AND ADJACENT PACIFIC OCEAN. Progress Report, July 1, 1966–June 30, 1967. Osterberg, Charles L. (Oregon State Univ., Corvallis. Dept. of Oceanography). Contract AT(45-1)-1750. 215p. Dep. CFSTI.

Hydrographic data on the northeast Pacific Ocean are presented. Results of studies on the ecology of fish and invertebrates in the northeast Pacific Ocean are included. (C.H.)

40746 (SC-DC-67-1857) CHARACTERISTICS OF SEVERAL CONCENTRATED-CHARGE, EXPLOSIVE-DRIVEN SHOCK TUBES. Mathews, F. H. (Sandia Corp., Albuquerque, N. Mex.). July 1967. 24p. (CONF-670712-2). Dep. CFSTI.

From Conference on Military Application of Blast Simulators, Calgary, Alberta, Canada.

The design and operating characteristics of several explosive-driven shock tubes are described. These shock tubes are driven by a disk (concentrated charge) of flake TNT or Composition C4 explosive. A plane axial detonation of the explosive was used to generate a plane shock wave in the shock tube. General design features of two 6-foot dia and a 2-foot dia shock tubes are presented, including a description of an expendable water-tamped driver section used to direct the explosive energy down the shock tube. Operating experience and test results obtained during several experiments using low-pressure air or sulfur hexafluoride as the test gas are presented. (auth)

40747 (SC-DC-67-2001) PRINCIPLES OF OPERATION OF THE INDIUM ADHESION TESTER USED FOR SURFACE CONTAMINATION MEASUREMENT. Krieger, G. L. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. Contract AT(29-1)-789. 7p. (CONF-670919-1). Dep. CFSTI.

From AEC/NSA Contamination Control Symposium, Albuquerque, N. Mex.

The basis for the use of solid–solid adhesion as a measure of surface cleanliness is discussed. Equipment and procedures are described for practical use of the effect and typical test results given. (auth)

40748 (SC-M-67-631) AMERICAN ASSOCIATION FOR CONTAMINATION CONTROL. Rocky Mountain Region Third Annual Technical Symposium, February 10, 1967, Albuquerque, New Mexico. (Sandia Corp., Albuquerque, N. Mex.). Contract AT(29-1)-789. 115p. (CONF-670215). Dep. CFSTI.

Medical and pharmaceutical applications of laminar air flow techniques in the Lunar Receiving Laboratory, as a biological barrier, in sterilization processes used for medical disposables, and in operating rooms are discussed as methods of contamination control. Discussions of air-borne contamination and its control in hospital design are also included. (F.S.)

40749 (SC-RR-66-602) TOODY: A COMPUTER PROGRAM FOR CALCULATING PROBLEMS OF MOTION IN TWO DIMENSIONS. Thorne, B. J.; Herrmann, W. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 166p. Dep. CFSTI.

Operational features of a FORTRAN computer program which solves the finite difference analogs to the Lagrangian equations of motion in two-dimensional rectangular and cylindrical coordinates are described. Separate stress and strain components are carried in the program so that problems of elastic-plastic motion can be treated. (auth)

40750 (SC-RR-67-532) LARGE DEFLECTION DYNAMIC RESPONSE OF CLAMPED CIRCULAR PLATES SUBJECTED TO EXPLOSIVE LOADING. Duffey, T. A. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. Contract AT(29-1)-789. 122p. Dep. CFSTI.

Clamped circular plates were impulsively loaded with sheet explosive, and the resulting large deflection dynamic response was monitored using high speed streak and framing cameras, and dynamic strain measurements. Both 6061-T6 aluminum (elastic-plastic, strain hardening) and 1022 steel (elastic-plastic, strain hardening, and strain rate sensitive) plates were tested. A simple rigid-plastic analysis, which predicts final deflection of the plate, is included. (auth)

40751 (SC-TM-67-561) AN ANALYSIS OF A CAPACITOR DISCHARGE TECHNIQUE FOR DETERMINING THE RISE TIME OF TEMPERATURE SENSORS. Dodge, Paul R. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 14p. Dep. CFSTI.

A method for determining the rise time of temperature sensors is described. The errors caused by local heat-transfer effects are examined. The magnitude of these errors is examined in detail. Three examples illustrating the problems involved are solved. (auth)

40752 (UCID-15161) A NEW APPROACH TO THE RELATIONSHIP BETWEEN THE P, QRS, T, AND U WAVES AS SEEN IN THE NORMAL ELECTROCARDIOGRAM. Silcocks, Harry; Higley, Wayne (California Univ., Livermore. Lawrence Radiation Lab.). June 12, 1967. Contract W-7405-eng-48. 13p. Dep. CFSTI.

If the atria and ventricles depolarize at given but different threshold voltage levels and cannot repolarize until the voltage drops below that threshold level, it is possible to explain the timing relation between the various complexes of the electrocardiogram by superimposing these voltages on a sine wave having the same frequency as the heart beat. This sine wave could occur as a result of coupling between two systems with different resonant frequencies. (auth)

40753 (UCID-15173) THE ANALYSIS OF CYCLOMETHYLENETETRANITRAMINE (HMX) AND AMMONIUM PERCHLORATE IN PLASTIC-BONDED EXPLOSIVES. Selig, Walter (California Univ., Livermore. Lawrence Radiation Lab.). July 20, 1967. Contract W-7405-eng-48. 9p. Dep. CFSTI.

A method for the analysis of plastic-bonded explosives containing HMX, ammonium perchlorate, and beeswax or polyethylene binder is presented. The binders are extracted with carbon tetrachloride. The ammonium perchlorate is then extracted with 50/50 (v/v) water/ethanol, leaving a residue of HMX. The ammonium perchlorate may also be analyzed by combustion in an oxygen bomb, followed by argentimetric titration of the resulting chloride. (auth)

40754 (UCID-15183) PORT MULTIPLEXOR INTERFACE NOTES. Hill, J. Carver (California Univ., Livermore. Lawrence Radiation Lab.). Nov. 15, 1966. Contract W-7405-eng-48. 13p. Dep. CFSTI.

The port multiplexor which enables twelve devices to share a single memory access channel on a strict priority basis and uses 100 nsec pulses to transmit data to the devices is described. (B.G.D.)

40755 (UCRL-17410) EFFECT OF PRESSURE ON HIGH-TEMPERATURE DISSOLUTION. Stett, Mark A.; Fulrath, R. M. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1967. Contract W-7405-eng-48. 20p. (CONF-670625-2). Dep. CFSTI.

From International Symposium on Kinetics of Reactions in Ionic Systems, Alfred, N. Y.

The effect of pressure on high temperature dissolution was investigated. Solubility of NiO in $Na_2O \cdot 2SiO_2$ glass was found to decrease with applied pressure, indicating that the entry rate of atoms from a solute into a solvent is decreased by increased pressure. The saturation concentration as measured with the electron beam microprobe was an accurate measurement of the liquidus concentration for a given temperature. (auth)

40756 (UCRL-17608) TABLE OF THE SOLUTIONS OF a $\tan(\pi x) = -b \tan(a\pi x)$. Concus, Paul (California Univ., Berkeley. Lawrence Radiation Lab.). June 2, 1967. Contract W-7405-eng-48. 6p. Dep. CFSTI.

The first ten positive values of x satisfying a $\tan(\pi x) = -b \tan(a\pi x)$ are given to four places for several values of a and b in the range $0.001 \leq a \leq 1.0$ and $0.001 \leq b \leq 1000$. (auth)

40757 (UCRL-17615) A THERMODYNAMIC STUDY OF THE HEAT OF ORDERING IN CuPt. Geiken, Gerald Wayne (California Univ., Berkeley. Lawrence Radiation Lab.). June 1967. Contract W-7405-eng-48. 20p. Dep. CFSTI.

Thesis.

The heat of formation of the equiatomic Cu-Pt alloy was measured as a function of temperature over the range 360 to 1155°K by means of liquid tin solution calorimetry. The results showed that the heat of formation decreases from -4010 cal/g-atom at 360°K to -4140 cal/g-atom at 800°K, and then increases again to -3070 cal/g-atom at a critical temperature of about 1100°K, at which a latent heat absorption of 440 cal/g-atom occurs. The results were interpreted as due to a disordering of the alloy as it is heated. The total ordering energy of the alloy was 1510 ± 100 cal/g-atom. (auth)

40758 (UCRL-70588) FRICTION AND VISCOELASTIC PROPERTIES OF HIGHLY FILLED POLYMERS: PLASTIC-BONDED EXPLOSIVES. Hoge, K. G. (California Univ., Livermore. Lawrence Radiation Lab.). July 27, 1967. Contract W-7405-eng-48. 54p. (CONF-680201-3). Dep. CFSTI.

For Presentation at 4th Southeastern Conference on Theoretical and Applied Mechanics, New Orleans, La.

Friction tests were conducted on four plastic-bonded explosives and one mock explosive with various surface finishes and at various sliding velocities, temperatures, and normal pressures. The amount of plastic binder material in these explosives varies from 15 to 3 wt %. This small amount of plastic is sufficient to cause these materials to behave in a viscoelastic manner. This viscoelastic effect is best illustrated by the dependence of the friction coefficient on sliding velocity. With increasing velocity, the coefficient first increases until a peak value is reached at a velocity of about 0.1 to 1.0 in./min, after which it decreases. To prove that this is a viscoelastic effect, the complex shear modulus of several of these explosives was experimentally determined at various frequencies and temperatures. By shifting these data to construct a master curve for both the loss and storage modulus at a reference temperature of 22°C, the constants in the Williams, Landel, Ferry (WLF) equation were evaluated. This form of the WLF equation is shown to relate sliding velocity and temperature for friction tests so that master plots for the friction coefficient may be made. Friction may be divided into adhesion, hysteresis and wear components. Wear is analyzed in terms of a model which predicts changes in the wear rate that occur during short sliding distances. The adhesion and hysteresis components are shown to be related to the shear loss modulus and the loss tangent, respectively, by relating sliding velocity to frequency. (auth)

40759 THE DIGITAL COMPUTER FOR SCIENTIFIC CALCULATIONS. I. Turrin, A. (CNEN, Frascati, Italy). G. Fis. Soc. Ital. Fis., 6: 171-82(July-Sept. 1965). (In Italian). (RT/FI-(66)7).

A brief description is given of the units comprising a computer. The logical decisions that a computer can make without outside direction are reviewed. The possibility of regulating a computer for reading data, reporting results, and processing data simultaneously is emphasized. (J.S.R.)

40760 PROCEEDINGS OF THE 21ST INDUSTRIAL WASTE CONFERENCE, MAY 3, 4, AND 5, 1966, PURDUE UNIVERSITY, LAFAYETTE, INDIANA. PART TWO. Purdue Univ., Eng. Bull., 50: Ext. Ser. No. 121, 639-1071(Mar. 1966). (CONF-660523-(Pt.2)).

Prints of 26 of the conference papers are presented in Part II. An abstract was prepared for one paper. Papers for which no abstracts were prepared are concerned primarily with sanitary waste. (J.R.D.)

For an abstract of the individual section see: 39166.

CORPORATE AUTHOR INDEX

This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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Digital computers in design of gas-cooled graphite-moderated reactors, 21:40521 (AEEW-M-754)
Effective fission cross sections in ZEBRA, 21:40420 (AEEW-R-526)
HAMBO: computer program for subchannel analysis of hydraulic and burnout characteristics of rod-clusters. I, 21:40522 (AEEW-R-524)
ATOMIC ENERGY OF CANADA LTD., CHALK RIVER (ONTARIO).
Fission product gas pressures developed in UO_2 fuel elements, 21:40693 (AECL-2662)
Heavy water power reactors, 21:40520 (AECL-2827)
Theoretical treatment of Zr--ZrO_2 epitaxy, 21:39641 (AECL-2751)

first layer of a fuel–Zn alloy and a second layer of one of the metals Pb, Bi, Sn, Be, Ca, Mg, Al, Si, V, or Fe. (NPO)

40717 NUCLEAR FUEL ELEMENT. (to CEA). French Patent 1,407,720. June 28, 1965. Filed June 22, 1964.

The fuel element is provided with an interlayer between the U core and the Mg alloy jacket, to prevent Pu diffusion. A preferred interlayer consists of an Al alloy with 0.5 to 12% Si and 0.5 to 5% Mg and has a thickness of 5 to 50 microns. Other suitable materials are Mo and/or Be. (NPO)

40718 FUEL ELEMENTS FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,421,874. Nov. 8, 1965. Priority date Jan. 30, 1964, Great Britain.

A fuel element is provided with a thermocouple cable running through a cutting device at the exterior of the elements, which device cuts the cable in two as soon as an abrupt traction is exerted on it. (NPO)

GENERAL

40719 (AD-650265) MATERIALS SCIENCES RESEARCH. Annual Technical Report, 1965-1966. (Illinois Univ., Urbana. Materials Research Lab.). Nov. 1, 1966. Contract SD-131. 157p. CFSTI.

Brief summaries are given of the status and results of research programs in the areas of cryogenics, crystallography, spectroscopy, metal physics, superconductivity, semiconductors, solid-state physics and electronics, phase studies, high-pressure research, radiation damage, and related topics. A complete listing of published papers and theses is included. (TAB)

40720 (CONF-661052) CONFERENCE ON "CONVERSATION WITH A 50" HELD AT ARGONNE NATIONAL LABORAOTRY, ILLINOIS, OCTOBER 31-NOVEMBER 1, 1966. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 102p. Dep. CFSTI.

Nine papers are presented on time-sharing conversational-mode programming systems with remote consoles for the IBM System/360 Model 50. (B.G.D.)

40721 (COO-299-2) COMPUTER EVALUATION OF "ENTROPY" TITRATION DATA: DETERMINATION OF β_i^0, ΔH_i^0 AND ΔS_i^0 VALUES FOR THE SILVER(I) PYRIDINE SYSTEM. Christensen, James J.; Eatough, Delbert; Izatt, Reed M.; Snow, Richard L. (Brigham Young Univ., Provo, Utah). Dec. 19, 1966. Contract AT(04-3)-299. 15p. (CONF-661128-1). Dep. CFSTI.

From American Chemical Society, Southwestern Regional Meeting, Albuquerque, N. Mex.

Log K_i, ΔH_i^0 and ΔS_i^0 values were determined for the stepwise formation of $AgPy_i^+$ (Py = pyridine) from Ag^+ and Py using a thermometric titration procedure. The results agree well with previously determined values and demonstrate that titration calorimetry can be used to determine log K, ΔH^0, and ΔS^0 values for metal-ligand systems. Four iterative methods of data analysis are compared and discussed. (auth)

40722 (COO-614-54) ICR QUARTERLY REPORT NUMBER 13. Yngve, Victor H. (Chicago Univ., Ill. Inst. for Computer Research). May 1, 1967. Contract AT(11-1)-614. 83p. Dep. CFSTI.

A progress report from the Institute for Computer Research is given. The main topics are Maniac III engineering activity, the Man-Machine project, the Uncill list-processing language, the approximation solvability of nonlinear equations, and a bi-directional simplex algorithm. (B.G.D.)

40723 (K-1723) EXISTENCE-UNIQUENESS THEOREMS FOR NON-LINEAR DIRICHLET PROBLEMS. Lick, Dale W. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). Aug. 23, 1967. Contract W-7405-eng-26. 9p. Dep. CFSTI.

Existence-uniqueness theorems are proved for the Dirichlet problems for the nonlinear equations $\nabla^2 u - [c_1 u/(1 + c_2 u)] = 0$, $u \geq 0$, $\nabla^2 u + [c_1/(1 + c_2 u)] = 0$, $u \geq 0$, and $\nabla^2 u - f(u) = 0$, $u \geq 0$ with boundary condition $u = \phi \geq 0$. (auth)

40724 (KAPL-M-6708) MIMIC: A DIGITAL SIMULATOR PROGRAM. Cullen, R. J.; Lechliter, G. L. (Knolls Atomic Power Lab., Schenectady, N. Y.). May 15, 1967. Contract W-31-109-eng-52. 59p. Dep. CFSTI.

A digital computer program, MIMIC, is described for solving systems of ordinary differential equations on a CDC-6600 computer with the SCOPE 2.0 operating system. MIMIC was written to provide those engineers and scientists who do not have backgrounds in computer techniques with a simple but effective means of communicating with a digital computer, yet the language is flexible enough to appeal to the professional programmer, either analog or digital. MIMIC is an advanced version of an earlier computer program called MIDAS. The execution time is very problem dependent. A typical second order model would run in <20 seconds. (auth)

40725 (KAPL-M-6709) SNEQ: A COMBINATION OF PROGRAMS TO PLOT CURVES AND/OR SOLVE NONLINEAR ALGEBRAIC EQUATIONS. Lechliter, G. L. (Knolls Atomic Power Lab., Schenectady, N. Y.). May 30, 1967. Contract W-31-109-eng-52. 35p. Dep. CFSTI.

Two computer programs that can be used in conjunction with the SLIP compiler for solving and/or displaying input equations are described. The two programs presented are: SNAP—a program to solve nonlinear, algebraic equations, and EQPLT—a program that reads equations as input and plots the results. This is extremely useful for parameter studies. Also, since these two programs both use the SLIP compiler, they have been combined and are both callable from within a single run. These programs are written in the FORTRAN-IV language. The approximate running time for a typical problem is 2 seconds. (auth)

40726 (LA-3717) EXPERIMENTS ON ERROR GROWTH ASSOCIATED WITH SOME LINEAR LEAST-SQUARES PROCEDURES. Jordan, T. L. (Los Alamos Scientific Lab., N. Mex.). June 1, 1967. Contract W-7405-eng-36. 9p. Dep. CFSTI.

Some numerical experiments were performed to compare the performance of procedures for solving the linear least-squares problem based on Gram-Schmidt, Modified Gram-Schmidt, and Householder transformations, as well as the classical method of forming and solving the normal equations. In addition, similar comparisons were made of the first three procedures and a procedure based on Gaussian elimination for solving an $n \times n$ system of equations. The results of these experiments suggest that: the Modified Gram-Schmidt procedure is best for the least-squares problem and that the procedure based on Householder transformations performed competitively; all the methods for solving least-squares problems suffer the effects of the condition number of ATA, although in a different manner for the first three procedures than for the fourth; and the procedure based on Gaussian elimination is the most economical and essentially the most accurate for solving $n \times n$ systems of linear equations. Some effects of pivoting in each of the procedures are included. (auth)

40727 (LA-DC-8921) COMPUTATIONAL METHODS IN THE NET-1 NETWORK ANALYSIS PROGRAM. Malmberg, Allan F. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 62p. Dep. CFSTI.

A computer program (NET-1) is described which is used for network analysis of linear and nonlinear electronic circuits. The computational methods are based upon the solution of simultaneous sets of nonlinear algebraic and differential equations. The transient and the dc steady-state problems are fully discussed. (B.G.D.)

40728 (BNL-11676) SOLUTION OF PROGRAMMING PROBLEMS BY GENERATING FUNCTIONS. Thurber, James K. (Brookhaven National Lab., Upton, N. Y.). [1967]. 73p. (CONF-670817-1). Dep. CFSTI.

From International Symposium on Mathematics Programming, Princeton, N. J.

A method has been developed for solving integer programming problems by using generating functions. By means of the generating functions the feasible solutions for a system with linear constraints can be represented in terms of new sets of integer variables which satisfy only the trivial constraints that they be nonnegative. The minimization problem then becomes a triviality in in principle although in practice it may lead to a tedious computation. Examples are included where both situations occur (i.e., where the method gives quick solutions and where it is impractical). The procedure is based on an extension and simplification of some ideas of P. A. MacMahon on the theory of partitions. In addition the method leads to some results in multiplicative number theory, greatly generalizing some well known identities involving the Riemann zeta function. The algorithm also has a continuous analog which amounts to solving simultaneous linear inequalities by means of Laplace transforms. The representation of the feasible solutions by means of Laplace transforms also eliminates all the non-trivial constraints and permits the minimization problem to be dealt with via classical methods of the calculus for non-linear objective functions and reduces the case of linear objective functions to a trivial although possibly tedious computation. (auth)

40729 (BNWL-493) PLUTONIUM ABSTRACTS. Volume 7, Number 6. Russell, Barbara G. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 30, 1967. Contract AT(45-1)-1830. 41p. Dep. CFSTI.

Summaries are presented of 105 publications from literature published throughout the world that report new developments in plutonium technology. The summaries are grouped under the following subject fields; biology and medicine, chemistry, health and safety, metallurgy and ceramics, physics, and reactor technology. (C.H.)

40730 (MIT-66TR51) SHAKE TABLE TESTS OF A SPIRAL-GROOVED JOURNAL BEARING. Malanoski, S. B. (Mechanical Technology Inc., Latham, N. Y.). Feb. 1967. Contract Nonr-3730(00). 28p. (AD-656398). Dep. CFSTI.

A 1.5 in. dia, L/D = 1, spiral-grooved, gas journal bearing with a rotor weight of 2½ lb. per bearing, mounted in a housing (total weight of approximately 100 lb.) was subjected to a one (1) g vibrating load over a frequency spectrum of 20 to 2000 cps. Tests

were made at rotor speeds of 12,000, 20,000 and 30,000 rpm. The only static bearing load imposed was the rotor weight. The in-line and perpendicular frequency responses of the rotor (both magnitude and phase angle) were measured and recorded. No sign of bearing touchdown was detected. Correlation between this experimental data and available theoretical data was good. (auth)

40731 (MLM-1358) DECOMPOSITION OF TOLYLENE DIISOCYANATE DIMER IN THE PRESENCE OF n-HEXANOL. Dichiaro, J. V. (Mound Lab., Miamisburg, Ohio). Aug. 4, 1967. Contract AT-33-1-GEN-53. 8p. Dep. CFSTI.

The reaction of 2, 4-tolylene diisocyanate dimer (TDID) with n-hexanol at 130°C was studied to establish the reaction course of TDID as a cross-linking agent for hydroxylated rubbers. A study of the reaction products by infrared spectrophotometry and thin-layer chromatography showed that TDID did not cleave during a 1 hr reaction. Thus, the TDID molecule reacts in a difunctional manner under these conditions. (auth)

40732 (NLCO-1001) SUMMARY TECHNICAL REPORT [ON FEED MATERIALS PRODUCTION], APRIL 1, 1967-JUNE 30, 1967. Burgett, R. (ed.) (National Lead Co. of Ohio, Cincinnati). Aug. 1967. Contract AT(30-1)-1156. 93p. Dep. CFSTI.

Progress is reported in seven sections and a separate abstract was prepared for each section. (M.C.G.)

For abstracts of individual sections see: 38874, 48999, 39000, 39561, 39615, 39684, and 39696.

40733 (NYO-2032-21) STUDIES OF HUMAN BONE MARROW TRANSPLANTATION IN ACUTE LEUKEMIA AND APLASTIC ANEMIA. Final Report, June 1, 1957-May 31, 1966. Dameshek, William (New England Medical Center Hospitals, Boston, Mass.). July 14, 1967. Contract AT(30-1)-2032. 5p. Dep. CFSTI.

Results are summarized from a series of animal studies that resulted in clinical trials of bone marrow transplants in the treatment of acute leukemia and aplastic anemia. Emphasis was placed on the use of antimetabolite drugs to minimize the rejection of transplanted tissues by the host. Good results were obtained using 6-mercaptopurine (6-MP), imuran (imidoyle 6-MP), cytoxan, and other analogs of 6-MP. Methods were developed for removing large amounts of bone marrow from normal individuals and injecting it into patients by the intravenous route. Other techniques studied included the injection of spleen tissues, the effects of tymectomy on immune reactions, and the effects of anti-lymphocyte serum on immune reactions to transplanted tissues. Results of clinical trials are reported. (C.H.)

40734 (NYO-3748-4) DATA MANAGEMENT SYSTEM FOR ON-LINE IMAGE PROCESSING ON A RELATIVELY SMALL COMPUTER. Curtis, Z. B.; Neurath, P. W.; Vetter, H. G. (Tufts-New England Medical Center, Boston, Mass.). Aug. 8, 1967. Contract AT(30-1)-3748. 3p. (CONF-670814-1). Dep. CFSTI.

From 12th Society of Photo-optical Instrumentation Engineers Symposium, Los Angeles, Calif.

The Data Management System (DMS) was designed for analysis of human chromosome spreads, but it is applicable to other image-processing tasks, especially where high spatial resolution is desired. The system operates with the IBM System 360 Model 30 computer using 32 K of core storage and a large, but relatively slow speed and inexpensive disk storage. The high-density scanning array contains 600,000 points. (W.E.B.)

40735 (ORNL-4156) PROBABILITY DISTRIBUTION ARISING IN A RIFF-SHUFFLE. Uppuluri, V. R. Rao.; Blot, W. J. (Oak Ridge National Lab., Tenn.). Sept. 1967. Contract W-7405-eng-26. 33p. Dep. CFSTI.

A discrete random variable X = 0, 1, 3, . . . , m-1, with probability density function $\binom{m+x-1}{x}(p^m q^x + q^m p^x)$, $p > 0$, $p + q = 1$, has arisen during the study of riff-shuffles as a Markov Process. An expression for the moment generating function of this variable is obtained, from which the mean and variance are derived. By equating two different expressions for the mean of the variable, a closed form for the incomplete beta function with equal arguments is obtained as $I_p(m,m) = p + (p-q)\sum_{k=1}^{m-1}\binom{2k-1}{k}(pq)^k$. It is shown how this expression helps for the rapid computation of the incomplete beta function with integral arguments. This expression is also used in deriving the asymptotic (m-large) expressions for the mean and variance. The standardized variate is shown to converge to the Gaussian distribution as $m \to \infty$. A result corresponding to the DeMoivre-Laplace type theorem is proved for m sufficiently large. Finally, applications are indicated to the genetic code problem, to Banach's match box problem and to the World Series of baseball. (auth)

40736 (ORNL-P-3296) ENGINEERING SUPPORT FOR THE MOLECULAR ANATOMY PROGRAM. Anderson, Norman G. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 16p. (CONF-670925-1). Dep. CFSTI.

From National Institute of Health Conference on Future Goals of Engineering in Biology and Medicine, Washington, D. C.

Engineering aspects of the development of techniques for cell production and cell fractionation are discussed. The major problem areas briefly described and discussed are as follows: cell culturing on a large scale; controlled cell breakage; development of automated analytical systems for the analysis of various classes of low molecular weight substances; development of automated systems for determining sequences in proteins and nucleic acids; development of automated systems for enzyme assay; development of data reduction techniques; development of higher resolution techniques for fractionation of mixtures of macromolecules; development of techniques for disassembly of each subcellular particle species; high resolution separation of subcellular fractions by centrifugal techniques; and integration of results with the aim of developing clinically useful diagnostic techniques. (B.H.S.)

40737 (ORO-2945-9) FASTENING OF WOOD-PLASTIC COMBINATIONS. Topical Report. Loos, Wesley E.; Kent, James A. (West Virginia Univ., Morgantown. Engineering Experiment Station). Sept. 1, 1967. Contract AT(40-1)-2945. 38p. Dep. CFSTI.

Fastening wood-plastic combinations (WPC) by both adhesives and mechanical fasteners was studied. Wood-plastic combinations can be satisfactorily glued before or after treatment. The gluability of several radiation produced wood-plastic combinations was tested with four commercially available adhesives. Resorcinal based adhesives gave the best results of the glues tested. Polyvinyl acetate (PVC) urea-formaldehyde (U-F) casein adhesives formed satisfactory glue bonds with WPC as long as the polymer loading of the WPC was not too high. By using WPC with a lower moisture content the glue bonds formed by PVC and U-F adhesives were much better than those produced by WPC with a high M. C. These results indicate that if U-F or PVA adhesives were formulated with a moisture diffusion rate to match that of the WPC, the glue bonds obtained would probably be improved. Mechanical fasteners such as conventional wood screws and threaded fasteners perform quite satisfactorily in fastening WPC. It is strongly advised not to try to nail WPC. Three threaded inserts plus a standard tapped hole and bolt were evaluated. All of these thread-type inserts gave high performance in fastening WPC. (auth)

40738 (ORO-3108-29) AN INVESTIGATION OF SOME PROPERTIES OF THREE DIMENSIONAL VOIDS IN FACE CENTERED CUBIC METALS. Sigler, Julius Alfred (Virginia Univ., Charlottesville). Aug. 1, 1967. Contract AT(40-1)-3108. 94p. Dep. CFSTI.

Thesis.

From data obtained for relative density changes as a function of strain in Au, it was concluded that there is no increase in density for small strains, and thus, that voids are not present in appreciable extent in furnace-cooled gold. The calculated value for the volume deficiency per dislocation segment is too high. A model was formulated and employed to explain the collapse of voids in quenched metals, and to a first approximation, the calculated results for the time of collapse as a function of quenching temperature are in good agreement with the observed behavior of Ni and Au. (M.C.G.)

40739 (PAEC(A)IN-631(Suppl.2)) NUCLEAR ENERGY IN THE PHILIPPINES, An Annotated Bibliography. (Philippine Atomic Energy Commission, Manila). Aug. 1966. 28p. Dep.

A bibliography including 75 references that cover research reports of the Philippine Atomic Energy Commission from April 1964 to December 1965 is presented. The bibliographic data included are author, title of publication, volume, date, and pages. A brief abstract of the article is also included. (B.G.D.)

40740 (RISO-M-587) A-4 SIZE EDITING. Poulsen, N. J. (Danish Atomic Energy Commission, Risoe. Research Establishment). July 1967. 5p. (R-10-67). Dep.

The program is used for producing a printed output of a symbolic tape on Teletype in such a way that the output appears in A-4 size. (auth)

40741 (RISO-M-595) ROUTINES FOR HYBRID COMPUTATIONS WITH EA1 680 AND PDP 8. la Cour Christensen, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). July 1967. 19p. (R-15-67). Dep.

A set of standard routines for hybrid computations are described. The routines cover analog input and output, relay-controlled potentiometer setting, interrupt identification for the hybrid interface

equipment, and conversion from fixed to floating points numbers and and vice versa. (auth) (DENM)

40742 (RISO-M-596) TEST PROGRAM FOR ANALOG INPUT EQUIPMENT 138E/139E FOR PDP8. la Cour Christensen, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). July 1967. 10p. (R-16-67). Dep.

The program is used to test the AD converter and multiplexer. The input channels are connected to stable and calibrated voltages, which are converted and printed out on the Teletype. Three operation modes are possible: A channel sequentially, one channel selected and all channels sequentially. (auth) (DENM)

40743 (RLO-1547-5) MANGANESE ABSORPTION BY BARLEY ROOTS. Maas, Eugene Vernon (Oregon State Univ., Corvallis). June 1967. Contract AT(45-1)-1547. 153p. Dep. CFSTI.

Thesis.

An investigation of Mn uptake by five-day-old excised barley roots revealed that a metabolically-mediated process was involved. In short-term experiments, the rate of Mn absorption was comparable to that of the macronutrient cations. Like other metabolically absorbed cations, the Mn absorption rate was a direct function of the ambient concentration and the pH. An evaluation of mutual effects between Mn and other cations revealed several specific regulatory effects. Of the alkali cations studied, Li alone had a pronounced stimulatory effect while Na, K and Rb markedly reduced the absorption of Mn. The alkaline earth cations also exerted widely differing effects. Calcium appeared to promote the absorption of Mn, whereas Mg had a highly inhibitive effect. The combination of both Ca and Mg was even more inhibitory. Strontium apparently was without effect and Ba had a moderately depressive effect. Other polyvalent cations which were effective inhibitors of Mn absorption were Fe^{++}, Zn, Cu, Al and La. In contrast, Fe^{3+} was virtually without effect. Manganese effectively blocked the absorption of Li and Mg, but greatly enhanced that of Na, K and Rb. These diverse regulatory effects and many others reported in the literature are explained by the following hypothesis: the cationic environment at the extracellular surface of the membrane is believed to control the specificity of the ion carrier. By attaching to critical activation sites, cations induce conformational changes in the carrier which modify its selective transport properties. The accessibility or affinity of transport sites for a given ion would depend on the particular configuration of the carrier. This mechanism, together with the mutual competition between some ions for the same transport site and the cationic maintenance of the cellular membranes, would explain most, if not all, of the regulatory effects exerted by cations on the ion absorption process. (auth)

40744 (RLO-1727-10) AQUATIC MYXOBACTERIA; CHONDROCOCCUS COLUMNARIS. Progress Report, 1967. Ordal, E. J. (Washington Univ., Seattle. Dept. of Microbiology). Aug. 15, 1967. Contract AT(45-1)-1727. 21p. Dep. CFSTI.

Progress is reported in epidemiological studies on fish, with emphasis on columnaris disease. Chondrococcus columnaris was isolated from cultures of Myxobacterales obtained from salmon in the Fraser River Basin, Columbia River Basin, and other areas in the Pacific Northwest suffering from columnaris disease, from salmon in Ireland suffering from Irish salmon disease, from fish from England where huge mortalities occurred in a variety of fish in the summer of 1966, and from diseased warm water pond fishes obtained from the southern U.S. Bacteria from the various sources were investigated for genetic relatedness by DNA competition, and the percentage of quanine and cytosine in DNA were determined by thermal denaturation. Analyses of virulence were carried out using the contact method of infection. The cultures of columnaris-like organisms from Irish salmon disease exhibited growth characteristics and pathological effects different from those of Pacific Northwest strains of C. columnaris. The effects of water temperature on the incidence of columnaris disease in fish and the pathogenicity of other aquatic myxobacteria in fish were also studied. (C.H.)

40745 (RLO-1750-22(Vol.3)) ECOLOGICAL STUDIES OF RADIOACTIVITY IN THE COLUMBIA RIVER ESTUARY AND ADJACENT PACIFIC OCEAN. Progress Report, July 1, 1966–June 30, 1967. Osterberg, Charles L. (Oregon State Univ., Corvallis. Dept. of Oceanography). Contract AT(45-1)-1750. 215p. Dep. CFSTI.

Hydrographic data on the northeast Pacific Ocean are presented. Results of studies on the ecology of fish and invertebrates in the northeast Pacific Ocean are included. (C.H.)

40746 (SC-DC-67-1857) CHARACTERISTICS OF SEVERAL CONCENTRATED-CHARGE, EXPLOSIVE-DRIVEN SHOCK TUBES. Mathews, F. H. (Sandia Corp., Albuquerque, N. Mex.). July 1967. 24p. (CONF-670712-2). Dep. CFSTI.

From Conference on Military Application of Blast Simulators, Calgary, Alberta, Canada.

The design and operating characteristics of several explosive-driven shock tubes are described. These shock tubes are driven by a disk (concentrated charge) of flake TNT or Composition C4 explosive. A plane axial detonation of the explosive was used to generate a plane shock wave in the shock tube. General design features of two 6-foot dia and a 2-foot dia shock tubes are presented, including a description of an expendable water-tamped driver section used to direct the explosive energy down the shock tube. Operating experience and test results obtained during several experiments using low-pressure air or sulfur hexafluoride as the test gas are presented. (auth)

40747 (SC-DC-67-2001) PRINCIPLES OF OPERATION OF THE INDIUM ADHESION TESTER USED FOR SURFACE CONTAMINATION MEASUREMENT. Krieger, G. L. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. Contract AT(29-1)-789. 7p. (CONF-670919-1). Dep. CFSTI.

From AEC/NSA Contamination Control Symposium, Albuquerque, N. Mex.

The basis for the use of solid–solid adhesion as a measure of surface cleanliness is discussed. Equipment and procedures are described for practical use of the effect and typical test results given. (auth)

40748 (SC-M-67-631) AMERICAN ASSOCIATION FOR CONTAMINATION CONTROL. Rocky Mountain Region Third Annual Technical Symposium, February 10, 1967, Albuquerque, New Mexico. (Sandia Corp., Albuquerque, N. Mex.). Contract AT(29-1)-789. 115p. (CONF-670215). Dep. CFSTI.

Medical and pharmaceutical applications of laminar air flow techniques in the Lunar Receiving Laboratory, as a biological barrier, in sterilization processes used for medical disposables, and in operating rooms are discussed as methods of contamination control. Discussions of air-borne contamination and its control in hospital design are also included. (F.S.)

40749 (SC-RR-66-602) TOODY: A COMPUTER PROGRAM FOR CALCULATING PROBLEMS OF MOTION IN TWO DIMENSIONS. Thorne, B. J.; Herrmann, W. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 166p. Dep. CFSTI.

Operational features of a FORTRAN computer program which solves the finite difference analogs to the Lagrangian equations of motion in two-dimensional rectangular and cylindrical coordinates are described. Separate stress and strain components are carried in the program so that problems of elastic-plastic motion can be treated. (auth)

40750 (SC-RR-67-532) LARGE DEFLECTION DYNAMIC RESPONSE OF CLAMPED CIRCULAR PLATES SUBJECTED TO EXPLOSIVE LOADING. Duffey, T. A. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1967. Contract AT(29-1)-789. 122p. Dep. CFSTI.

Clamped circular plates were impulsively loaded with sheet explosive, and the resulting large deflection dynamic response was monitored using high speed streak and framing cameras, and dynamic strain measurements. Both 6061-T6 aluminum (elastic-plastic, strain hardening) and 1022 steel (elastic-plastic, strain hardening, and strain rate sensitive) plates were tested. A simple rigid-plastic analysis, which predicts final deflection of the plate, is included. (auth)

40751 (SC-TM-67-561) AN ANALYSIS OF A CAPACITOR DISCHARGE TECHNIQUE FOR DETERMINING THE RISE TIME OF TEMPERATURE SENSORS. Dodge, Paul R. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 14p. Dep. CFSTI.

A method for determining the rise time of temperature sensors is described. The errors caused by local heat-transfer effects are examined. The magnitude of these errors is examined in detail. Three examples illustrating the problems involved are solved. (auth)

40752 (UCID-15161) A NEW APPROACH TO THE RELATIONSHIP BETWEEN THE P, QRS, T, AND U WAVES AS SEEN IN THE NORMAL ELECTROCARDIOGRAM. Silcocks, Harry; Higley, Wayne (California Univ., Livermore. Lawrence Radiation Lab.). June 12, 1967. Contract W-7405-eng-48. 13p. Dep. CFSTI.

If the atria and ventricles depolarize at given but different threshold voltage levels and cannot repolarize until the voltage drops below that threshold level, it is possible to explain the timing relation between the various complexes of the electrocardiogram by superimposing these voltages on a sine wave having the same frequency as the heart beat. This sine wave could occur as a result of coupling between two systems with different resonant frequencies. (auth)

40753 (UCID-15173) THE ANALYSIS OF CYCLOMETHYLENETETRANITRAMINE (HMX) AND AMMONIUM PERCHLORATE IN PLASTIC-BONDED EXPLOSIVES. Selig, Walter (California Univ., Livermore. Lawrence Radiation Lab.). July 20, 1967. Contract W-7405-eng-48. 9p. Dep. CFSTI.

A method for the analysis of plastic-bonded explosives containing HMX, ammonium perchlorate, and beeswax or polyethylene binder is presented. The binders are extracted with carbon tetrachloride. The ammonium perchlorate is then extracted with 50/50 (v/v) water/ethanol, leaving a residue of HMX. The ammonium perchlorate may also be analyzed by combustion in an oxygen bomb, followed by argentimetric titration of the resulting chloride. (auth)

40754 (UCID-15183) PORT MULTIPLEXOR INTERFACE NOTES. Hill, J. Carver (California Univ., Livermore. Lawrence Radiation Lab.). Nov. 15, 1966. Contract W-7405-eng-48. 13p. Dep. CFSTI.

The port multiplexor which enables twelve devices to share a single memory access channel on a strict priority basis and uses 100 nsec pulses to transmit data to the devices is described. (B.G.D.)

40755 (UCRL-17410) EFFECT OF PRESSURE ON HIGH-TEMPERATURE DISSOLUTION. Stett, Mark A.; Fulrath, R. M. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1967. Contract W-7405-eng-48. 20p. (CONF-670625-2). Dep. CFSTI.

From International Symposium on Kinetics of Reactions in Ionic Systems, Alfred, N. Y.

The effect of pressure on high temperature dissolution was investigated. Solubility of NiO in $Na_2O \cdot 2SiO_2$ glass was found to decrease with applied pressure, indicating that the entry rate of atoms from a solute into a solvent is decreased by increased pressure. The saturation concentration as measured with the electron beam microprobe was an accurate measurement of the liquidus concentration for a given temperature. (auth)

40756 (UCRL-17608) TABLE OF THE SOLUTIONS OF a $\tan(\pi x) = -b \tan(a\pi x)$. Concus, Paul (California Univ., Berkeley. Lawrence Radiation Lab.). June 2, 1967. Contract W-7405-eng-48. 6p. Dep. CFSTI.

The first ten positive values of x satisfying $a \tan(\pi x) = -b \tan(a\pi x)$ are given to four places for several values of a and b in the range $0.001 \leq a \leq 1.0$ and $0.001 \leq b \leq 1000$. (auth)

40757 (UCRL-17615) A THERMODYNAMIC STUDY OF THE HEAT OF ORDERING IN CuPt. Geiken, Gerald Wayne (California Univ., Berkeley. Lawrence Radiation Lab.). June 1967. Contract W-7405-eng-48. 20p. Dep. CFSTI.

Thesis.

The heat of formation of the equiatomic Cu-Pt alloy was measured as a function of temperature over the range 360 to 1155°K by means of liquid tin solution calorimetry. The results showed that the heat of formation decreases from -4010 cal/g-atom at 360°K to -4140 cal/g-atom at 800°K, and then increases again to -3070 cal/g-atom at a critical temperature of about 1100°K, at which a latent heat absorption of 440 cal/g-atom occurs. The results were interpreted as due to a disordering of the alloy as it is heated. The total ordering energy of the alloy was 1510 ± 100 cal/g-atom. (auth)

40758 (UCRL-70588) FRICTION AND VISCOELASTIC PROPERTIES OF HIGHLY FILLED POLYMERS: PLASTIC-BONDED EXPLOSIVES. Hoge, K. G. (California Univ., Livermore. Lawrence Radiation Lab.). July 27, 1967. Contract W-7405-eng-48. 54p. (CONF-680201-3). Dep. CFSTI.

For Presentation at 4th Southeastern Conference on Theoretical and Applied Mechanics, New Orleans, La.

Friction tests were conducted on four plastic-bonded explosives and one mock explosive with various surface finishes and at various sliding velocities, temperatures, and normal pressures. The amount of plastic binder material in these explosives varies from 15 to 3 wt %. This small amount of plastic is sufficient to cause these materials to behave in a viscoelastic manner. This viscoelastic effect is best illustrated by the dependence of the friction coefficient on sliding velocity. With increasing velocity, the coefficient first increases until a peak value is reached at a velocity of about 0.1 to 1.0 in./min, after which it decreases. To prove that this is a viscoelastic effect, the complex shear modulus of several of these explosives was experimentally determined at various frequencies and temperatures. By shifting these data to construct a master curve for both the loss and storage modulus at a reference temperature of 22°C, the constants in the Williams, Landel, Ferry (WLF) equation were evaluated. This form of the WLF equation is shown to relate sliding velocity and temperature for friction tests so that master plots for the friction coefficient may be made. Friction may be divided into adhesion, hysteresis and wear components. Wear is analyzed in terms of a model which predicts changes in the wear rate that occur during short sliding distances. The adhesion and hysteresis components are shown to be related to the shear loss modulus and the loss tangent, respectively, by relating sliding velocity to frequency. (auth)

40759 THE DIGITAL COMPUTER FOR SCIENTIFIC CALCULATIONS. I. Turrin, A. (CNEN, Frascati, Italy). G. Fis. Soc. Ital. Fis., 6: 171-82(July-Sept. 1965). (In Italian). (RT/FI-(66)7).

A brief description is given of the units comprising a computer. The logical decisions that a computer can make without outside direction are reviewed. The possibility of regulating a computer for reading data, reporting results, and processing data simultaneously is emphasized. (J.S.R.)

40760 PROCEEDINGS OF THE 21ST INDUSTRIAL WASTE CONFERENCE, MAY 3, 4, AND 5, 1966, PURDUE UNIVERSITY, LAFAYETTE, INDIANA. PART TWO. Purdue Univ., Eng. Bull., 50: Ext. Ser. No. 121, 639-1071(Mar. 1966). (CONF-660523-(Pt.2)).

Prints of 26 of the conference papers are presented in Part II. An abstract was prepared for one paper. Papers for which no abstracts were prepared are concerned primarily with sanitary waste. (J.R.D.)

For an abstract of the individual section see: 39166.